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ECONOMIC GEOGRAPHY

JULY

AGRICULTURAL REGIONS OF AFRICA
H. L. Shantz

BROOMCORN INDUSTRY OF COLES COUNTY, ILLINOIS
Louise M. Trager

EVOLUTION OF THE IRISH RAILWAY SYSTEM
Charles A. Fisher

CURRENT TRENDS IN CALIFORNIA ORCHARDS AND VINEYARDS
Peveril Meigs, III

LAND USE PATTERNS OF THE INNER BLUEGRASS
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INDUSTRIAL GEOGRAPHY OF LOWER WABASH VALLEY
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URBAN GROWTH IN THE SAN DIEGO REGION
Nicholas Mirkowich

TACOMA, LUMBER METROPOLIS
Gertrude L. McKean

CLARK UNIVERSITY, WORCESTER, MASSACHUSETTS, U.S.A.

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RAILWAYS

IF they should ever be wholly superseded by other forms of transportation, railways would have made their major and substantial contribution to development of industry, progress of civilization, and improved standard of living among peoples of the whole world. The civilizing rails, as Mark Jefferson so happily phrased the rôle they have played in man's achievement of economic ease and convenience and cultural eminence, broke down distance as barrier over most of the land surface of the earth and made of the wilderness home for millions of folk.

The likelihood that railways will soon, if ever, be displaced as the primary and most important means of carriage of the great bulk of goods produced in forest, or mine, or factory, or on the farm, seems slight indeed. Truck nor airplane, though bearing increasingly larger burdens of freight, can be counted on to take over from railways the task of keeping the world's raw materials moving to mart or factory, the finished goods to their destination for use or consumption.

In time of peace when all transport is not taxed to capacity, railways may suffer in competition with faster means of transport; but in time of war they resume their place of preëminence and indispensability. Every transportation emergency reëmphasizes the value of railways; they should not be permitted to lose their operating efficiency.

ECONOMIC GEOGRAPHY

VOL. 17 JULY, 1941 No. 3

AGRICULTURAL REGIONS OF AFRICA

PART II. VEGETATION AND POTENTIAL PRODUCTIVITY OF THE LAND (*Continued*)

H. L. Shantz

IN discussing such topics as forest, woodland, grazing land of high carrying capacity, grazing land of low carrying capacity, grazing land suitable for cattle, grazing land suitable for sheep and goats, land suitable for cool-weather crops and land suitable for warm-weather crops, there is much overlapping. For example, almost all of Liberia is forest and also potential warm-weather crop land, while Basutoland is grazing land of high carrying capacity and it is also suitable for the production of cool-weather crops. In the maps of each colony the areas shown as grazing only, cool-weather crops, and warm-weather crops, do not overlap and these three groups total the area of the colony.

The land in each colony has been divided into

(a) land suitable for the production of warm-weather crops,
(b) land suitable for the production of cool-weather crops,
(c) land incapable of crop production and suitable only to grazing.

The areas are expressed as 1,000 square miles. More exact areas are given in Table VII (April 1940 issue, p. 147).

Lands classed as grazing only are often non-grazing lands because of too sparse vegetation cover or lack of water for livestock. Most of the grazing is actually on land capable of crop production.

In the discussion of lands suitable for crop production it should be borne in mind that this is an over-all classification and includes all land lying in a suitable climate and land with unfavorable topography, and that in such countries as the United States only about half of the land with suitable climate has actually been placed under cultivation. As population pressure demands the extension of cultivation of lands it is probable that only about half of the areas here listed will ever come under actual cultivation. The African method of using land only for a few years and then allowing it to lie idle would also mean that a large portion of the cultivable land would not actually be in crop.

The division of agricultural crops

into temperate and tropical is difficult since many of the crops which thrive best in the tropics require relatively cool weather and many of the temperate zone crops require warm weather. The terms temperate and tropical when applied to crops have more of a geographical than a physiological or ecological meaning.

Cool-weather crops of importance in the tropics often cannot be grown in the temperate zone because of frost. Important species of bananas and coffee do well on the cool mountains of central Africa where temperatures do not rise above 85 degrees or fall below about 65 degrees Fahrenheit. Frost or low temperatures exclude these crops from temperate zone areas. Cotton and rice which push north into the temperate zone endure high temperatures and grow well during warm weather but would not succeed in a cool climate. Therefore, almost all temperate zone crops can be grown in parts of the tropics but tropical fruits will not grow in the temperate zone because of the damage of frost or low temperatures.

The most prominent warm-weather crops in Africa are:

Native Production	*European Production*
Sorghums and Millets	Maize
Maize	Sorghums and Millet
Cotton	Sugar cane
Groundnuts	Citrus fruits
Manioc	Coffee
Rice	Sisal
Sweet potatoes	Coconuts
Sesame	Tobacco
Oil palm	Cotton
Cacao	Cacao
Sisal	Oil palm
Coconut	Rubber
Tobacco	Pineapple
Cloves	Groundnuts
Sugar cane	Bananas
Vanilla	Coffee (Liberian and robusta)
Rubber	Ginger
Ginger	Vanilla
Kapok	
Voandzeia	
Chillies	
Bananas	
Coffee (Liberian and robusta)	

The most prominent cool-weather crops are:

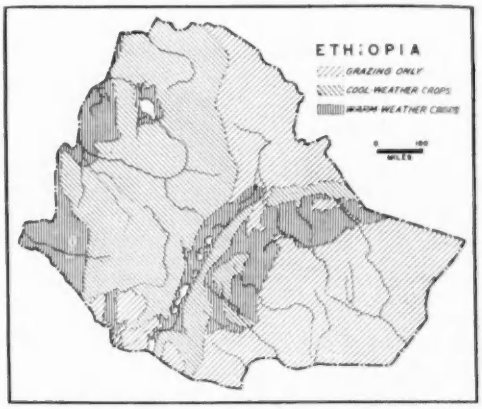

FIGURE 151.—Ethiopia has an area of 350,000 square miles. Of this area 139,000 square miles are suitable for production of cool-weather crops, and 58,000 square miles are suitable for production of warm-weather crops. Arid land incapable of crop production is shown under the caption "Grazing only" and amounts to 153,000 square miles.

Native Production	*European Production*
Wheat	Wheat
Barley	Oats
Peas and Beans	Barley
Bananas	Deciduous fruits
Coffee (Arabian)	Vines
Potatoes	Teff
Wattle	Peas and Beans
Linseed	Lucerne
Teff	Rye
	Potatoes
	Tea
	Bananas
	Coffee (Arabian)

These divisions are more or less arbitrary since no adequate study has been made of the exact temperature relations of most of our cultivated crops. Laboratory measurements are often very misleading since the growth rate may be rapid in high temperatures which would not permit production of a crop. The location of a crop would signify little since, for example, wheat is grown in Alberta in June and July while the same crop in southern Arizona would be grown in February and March. In the temperate zone, annual crops and especially short season crops can be fitted into any part of the year during which temperature conditions are best

suited to their successful growth. Perennial or long season crops cannot be so adjusted. In the temperate zone there are no areas where the temperature is cool and where at the same time there are no frosts. The highlands of the tropics afford just such an environment. There most temperate crops except those requiring high temperature can be grown and also tropical crops which can grow successfully at low (less than 85 to 90 degrees F.) temperatures, and which are here referred to as cool-weather crops.

Varieties of coffee and many other crops are adapted to different temperature conditions and while Arabian coffee is at home on the cool highlands of Ethiopia, the large berry Liberian coffee and robusta coffee are equally at home in the hot, humid Liberian forests. Bananas, of which there are many hundreds of varieties, also have forms which grow best on the cool mountains of central Africa while others do well in the lower country.

A great variety of crops can be grown at high elevations in the cooler tropics and at lower elevation these give way to the warm-weather crops. At some places in a colony like Kenya or Tanganyika almost any crop can be grown.

In this classification warm-weather crops include the typically tropical crops such as vanilla, ginger, cacao, manioc, oil palm, coconut, pineapple, cloves, sugar cane, rubber, kapok, and tropical fruits, as well as cotton, sorghum, rice, groundnuts, tobacco, and citrus fruits which also thrive in warm weather in the temperate zone.

Cool-weather crops include such tropical crops as banana, coffee, tea, and such temperate crops as wheat, barley, oats, teff, and flax.

ETHIOPIA

Ethiopia occupies a great highland in northeast Africa, through which the Rift Valley leads southeast from Djibouti to Hawash and on to Lake Rudolf. The drainage south and east is into desert country in Italian Somaliland and Eritrea. The greatest drainage is west where it feeds the Sobat, Blue Nile, and Atbara rivers to furnish about 89 per cent of the water of the lower Nile. The area of Ethiopia is about 350,000 square miles.

FIGURE 152.—Land prepared for crops by a native plow pulled by cattle is left rough, thus providing an ideal surface for absorption of rain water. Addis Ababa, Ethiopia.

The great highlands are cut by cañons and the surface is broken by mountains. The eastern escarpment leads down to lowland desert country and the western to the savanna country of the Anglo-Egyptian Sudan. Great physiographic features present a varied environment with contrasting vegetation types ranging from desert to temperate rain forest.

Temperate rain forests are found in the higher mountains and protected slopes and occupy about 23,000 square miles. The dry forests, about 12,000 square miles in extent, are valuable for timber, gums, wood, grazing, and as crop land. Thorn forests produce wood and gums but grow on land too dry for crop production without irrigation.

Acacia–tall grass savanna is grazing land of high carrying capacity, suitable especially for crops of cotton and sorghum and occupying about 46,000 square miles, mostly west and southeast of the highlands. Lands suitable for grazing only are indicated by the acacia–desert grass savanna covering about 105,000 square miles, mostly adjacent to Italian Somaliland and Eritrea. This is grazing land which produces also wood and gums. These are usually the best lands for hunting, for here herds of the antelope groups and the giraffe, rhinoceros, zebra, and lion and other carnivores are often concentrated.

FIGURE 153.—Cakes of cow dung are set up to be thoroughly dried. On much of the Ethiopian plateau this is one of the principal sources of fuel. Cow dung is also used to wash walls and floors of huts in many parts of Africa. Addis Ababa, Ethiopia.

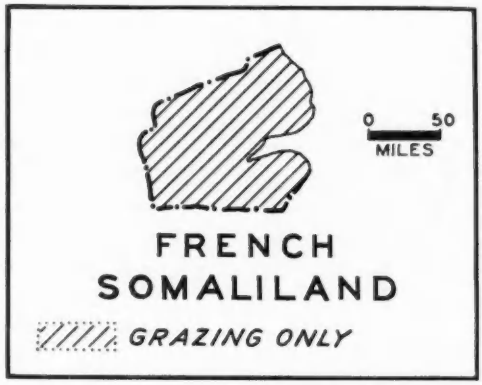

FIGURE 154.—French Somaliland has an area of nearly 6,000 square miles. There is no agricultural land and the total area is suitable for grazing only.

The mountain grassland is ideal for grazing and is productive of cool-weather crops. The climate is healthful and invigorating. Probably much of the 116,000 square miles was once forested.

More extreme desert lying east along the boundary of Eritrea is desert shrub and desert grass country, good grazing land of low carrying capacity where drinking water is available for livestock, and occupying about 23,000 square miles.

Land Use.—Forests and woodlands. The forests of Ethiopia were probably once much more extensive than they are now. Less than 7 per cent is now forest, about 23,000 square miles. Woodlands, mostly along the edges of the plateau and of deciduous trees and thorn trees, cover about 10 per cent of the area, 37,000 square miles.

Grazing lands of high carrying capacity, mostly in the highlands and in the best agricultural area, cover about 174,000 square miles, about half of the total land area. A somewhat smaller block of land of 153,000 square miles, 44 per cent of the area, is grazing land of low carrying capacity.

If cattle alone are considered, the total area of grazing land would amount to 292,000 square miles, an area sufficient for at least 3 or 4 million head. Almost all the land is suitable for sheep and goats, about 327,000 square miles, which should furnish forage for from 30 to 40 million animals if other uses were subordinated.

Cattle, goats, sheep, horses, donkeys, mules, and camels are produced. If expressed in animal units grazed on the 237,000 square miles of grazing land, a density of about 21 per square mile would be indicated, if the proportion of goats and sheep to other livestock is maintained in Ethiopia the same as for the continent as a whole. (An animal unit is 1 cow, or 1 horse, or 1 donkey, or 1 mule, or 1 camel, or 5 sheep, or 5 goats, or 5 pigs, or 5 ostriches. The total for the continent is 51,974,000, or 5.4 animal units per square mile of land suitable for grazing.)

Lands Capable of Crop Production.—Lands which receive sufficient rainfall to justify cultivation comprise an area of about 197,000 square miles, more than half the total area. Of these lands about 70 per cent lies at elevations sufficient to bring about weather conditions favorable to cool-weather crops while only about 30 per cent lies in a climate favorable to warm-weather crops.

Land Classification.—About 58,000 square miles of land capable of producing warm-weather crops, 17 per cent of the total area, lies at low elevations, and has warm climate and unequally distributed rainfall. Most of this type of land lies along the west side next to the Anglo-Egyptian Sudan, and also along the Rift Valley as well as in a zone from British Somaliland past Harrar extending west and south toward the Kenya boundary. The rains are chiefly in midsummer but may extend from March or April to August or September. The natural plant cover is valuable as grazing land of rank rich grass and scattered open forests. Rather dense populations have reduced much of this land to crop lands where cotton, sorghums, millets, sweet potatoes, and vegetables are grown. Of the grain sorghums the Kaffir corn and durro produce much of the food, and most of the wearing apparel is woven by hand from cotton grown on these lands. If necessary, it is probable that as much

FIGURE 155.—This is part of the desert of French Somaliland. Near the coast it is a saline desert of no value for agriculture or for grazing. Near Djibouti, French Somaliland.

as 3 million acres could be used to produce cotton in Ethiopia without interfering with the production of sufficient grain sorghum and other food crops.

On the plateau and on the mountain ranges there are about 139,000 square miles of land, 40 per cent of the total area, with climate suitable for cool-

FIGURE 156.—The native city Djibouti is a sharp contrast to the modern city shown in Figure 157. Djibouti, French Somaliland.

weather crops. Here are excellent grazing lands and lands capable of producing wheat, barley, teff, and chick peas. Here temperate deciduous and citrus fruits and vines do well. Native hay is cut and marketed and horses, mules, donkeys, cattle, sheep, and goats are fed throughout the year.

The list of crops which could be produced in these highlands of Ethiopia would include practically all the temperate crops grown in the United States. At very high elevation frost plays a part in limiting crop production, but in almost all of this area bananas and coffee do well. Coffee grows as a wild plant in Kaffa and these wild plants are used in establishing plantations. Lands planted each year to barley, wheat, oats, and teff may equal 5 to 8 million acres.

Agriculture in Ethiopia is considerably in advance of native agriculture in central and southern Africa, since cattle have been used to plow the lands. The land is worked over by a primitive plow (see Figure 7) and the seed is covered by the same process. The ground is left rough (Figure 152), thus providing an excellent surface for the absorption of rainfall. It is doubtful if the use of the European plow could so easily prepare the land and if it would be left in as good condition for the crop. This is especially true in the preparation of dry and stony land for crop production. Teff, a staple bread crop, is produced on the "black cotton soils," rich black colloidal soils with no drainage. These soils when wet are puddled by driving herds of domestic animals through them and the seeds of teff are scattered on this wet muddy surface. The crop production on such areas is often very heavy.

There is an area of about 153,000 square miles, 44 per cent of the total area, where the climatic conditions are not favorable to crop production and where the vegetation is sparse, consisting of desert shrubs and grasses and thorn trees. Much of this land is good grazing land of low carrying capacity. It might be expected to support 1 to 2 million cattle (Figure 153). In this area crops are produced only by artificial or natural irrigation. Natural forage and dependent domestic livestock constitute the food basis on which the native population subsists.

The Somali people are scattered very thinly over this extensive area. They produce skins, hides, and ghee for export and consume very little of the produce of the outside world. This is probably the best use for country of this type and the population density must always be low. Overstocking will reduce the carrying capacity and during exceptionally dry years cause death of the herds and probably famine for the natives. At present the density of occupancy and the degree of use is in

balance with subnormal years which naturally safeguards the plant cover, whereas, if the dry years could be successfully passed by the use of stored or imported feed, the area could be severely overused and the average of production lowered. To the animal products should be added gum which is collected from the various desert leguminous trees. These lands suitable for grazing only, occupy most of the northeastern and southeastern portions. The people are nomadic, following the forage and dependent in their movements to some extent on the distribution of rains which come for the most part in summer.

The agricultural potentialities of Ethiopia are not well expressed in the exports since it is largely self-supporting. Exports are principally coffee, hides and skins, and beeswax. These may amount to as much as $25.00 per square mile of land suitable for crop production.

The population density is estimated at about 17 per square mile, or if only land potentially capable of crop production is considered, at about 30 per square mile. There are about 6,667 natives to one European.

SOMALILAND (FRENCH)

There are less than 6,000 square miles of desert land in Somaliland (Figure 154), none of which lie in a climate favorable to agricultural production without irrigation. There are less than 1,000 square miles of thorn forest of value for wood and gum. The whole area can be grazed, but much of it is almost bare desert with desert shrubs and grasses marking, by their sparse growth, the drainage channels which are dry except during showers. Minerals and salt are the only products. Except as a port (Djibouti) from which exports are shipped which originate in Ethiopia, it has no agricultural significance.

There are estimated to be about 15 people per square mile of area (Figure 155). This means little, for most of them reside in Djibouti. There are about 159 natives (Figure 156) to every European inhabitant (Figure 157).

SOMALILAND PROTECTORATE (BRITISH)

This area of about 68,000 square miles lies south of the Gulf of Aden (Figure 158). About 59,000 square miles of land are incapable of crop production except under irrigation which cannot be developed to any great extent because of lack of water. This land is grazing land of low carrying capacity but supports a nomadic people who live on their herds of camels, cattle, horses, donkeys, sheep, and goats. The principal exports are hides, skins, ghee, and gums. About 9,000 square miles have a grass cover with scattered acacia trees and are capable of producing warm-weather food crops which are locally consumed. Such foods as dates, rice, and sugar are imported.

FIGURE 157.—Rue du Porte, one of the main streets in Djibouti. French Somaliland.

Thorn forests of about 6,000 square miles, 9 per cent of the total area, produce wood and gums, and to these may be added the acacia–desert grass

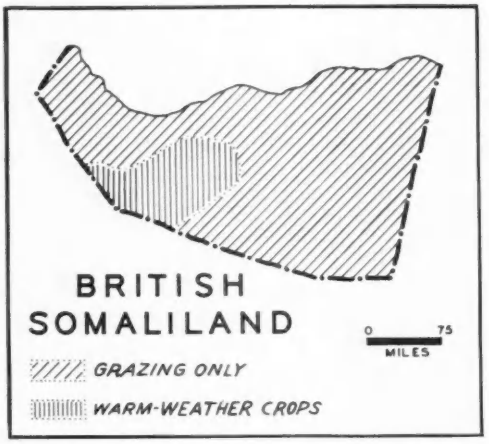

FIGURE 158.—British Somaliland has an area of about 68,000 square miles. Of this area 9,000 square miles are suitable for warm-weather crops and 59,000 square miles are suitable for grazing only.

savanna of about 27,000 square miles. Of grazing lands of high carrying capacity there are only about 9,000 square miles in addition to the 59,000 of low carrying capacity. Sheep and goats and camels can utilize the whole area. Cattle are probably shut out of some of the area because of dense thickets. The principal agricultural exports are sheep, goats, cattle, skins, hides, ghee, and gum. There are about 5.5 inhabitants per square mile.

ERITREA

Eritrea has about 46,000 square miles divided between arid or desert country and highland covered by an open stand of thorn forests (Figure 159). About 17,000 square miles, 46 per cent of the area, is suitable for cotton, corn, sorghums, and barley and wheat. Much of the production is by irrigation, the water drawn from the Ethiopian highlands.

Practically all of the area can be grazed and produces cattle, sheep, goats, mules, and camels. The domestic animal units amount to 1,311,000, about 19 per square mile of grazing land. There are about 8.9 inhabitants per square mile and about 86 natives to one European. On the basis of land capable of crop production the population density would be 24 per square mile.

SOMALILAND (ITALIAN)

Somaliland has an area of about 232,000 square miles covered by acacia–desert grass savanna and desert shrub–desert grass (Figure 160). In Table VIII-A (October 1940 issue, p. 361) both types are combined as desert grass savanna. This land is dry and hot but is grazing land of low carrying capacity. Thickets or thorn forests are estimated to occupy about 14,000 square miles, 6 per cent of the area. These areas are productive of cattle, mules, sheep, goats, camels, game, wood, and gums. The domestic livestock amounts to about 2,047,000, or 8.8 animal units per square mile of grazing land.

Under irrigation, especially in southern Somaliland, along the Juba River, maize, cotton, sesame, sugar cane, and many other warm-weather crops are raised. Hides, skins, cotton, sheep, and goats are the principal exports. No

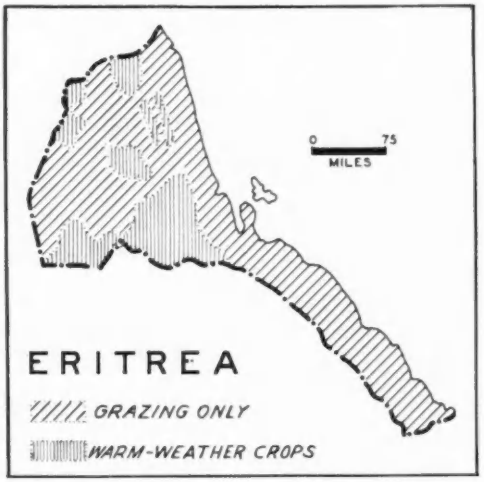

FIGURE 159.—Eritrea has an area of nearly 46,000 square miles. Of this area 17,000 square miles are suitable for warm-weather crops and 29,000 square miles are suitable for grazing only.

areas are suitable for crop production without irrigation.

There are 5.2 people per square mile and about 1,200 natives to one European.

EGYPT

Egypt is a relatively flat desert divided by the Nile River, which irrigates the lands adjacent (Figure 161). It occupies about 383,000 square miles of the northeast corner of Africa. It contains the Senai Peninsula between the Red Sea and the Mediterranean, the Arabian desert between the Red Sea and the Nile, and part of the Lybian desert west of the Nile.

The vegetation ranges from extreme desert to rich well-watered lands (oases) in a hot, dry climate. The oases and banks of the Nile occupy about 10,000 square miles of land naturally productive of trees, shrubs, and grasses but which have been modified by the introduction and cultivation of hundreds of kinds of useful plants.

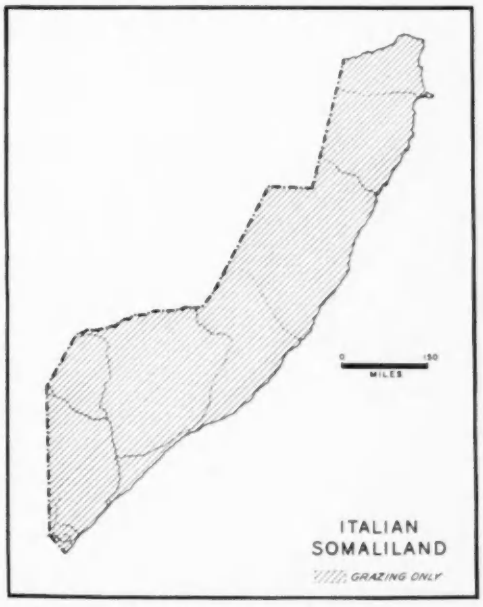

FIGURE 160.—Italian Somaliland has an area of nearly 232,000 square miles. Except where irrigated there is no land suitable for crop production. The area of grazing land only is 232,000 square miles.

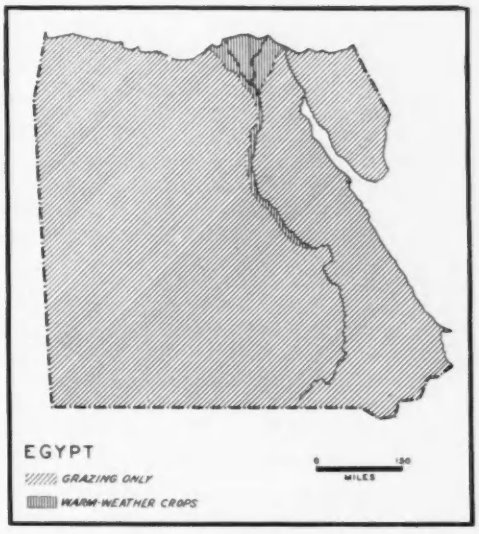

FIGURE 161.—Egypt has an area of 383,000 square miles. Of this area about 10,000 square miles are irrigated or sub-irrigated and are suitable for production of warm-weather crops. The remaining area of 373,000 square miles is suitable for grazing only.

The desert covers about 98,000 square miles lying mostly in the central part of the Egyptian portion of the Lybian desert. Much of this is moving dunes which at times afford forage after rains but are for the most part bare of vegetation.

Desert shrubs cover a large part of the area or about 261,000 square miles. In places the shrubs are small and far apart but at other times afford a plant cover of value to camels, cattle, sheep, and goats.

The best grazing land, the acacia–desert grass, covers probably about 14,000 square miles and lies mostly along the drainage courses in southeastern Egypt. Here gums are produced and grass is available for grazing animals.

Land Use.—There are no forests but the acacia–desert grass savanna furnishes some wood and gums. Grazing land of very low carrying capacity covers about 275,000 square miles,

FIGURE 162.—Egypt is the most productive part of Africa. Here wheat straw is placed in bags preparatory to shipment. Kom Ombu, Egypt.

72 per cent of the area. The principal animals are cattle, sheep, donkeys, goats, camels, horses, mules, and pigs, totalling about 2,860,000 animal units, 10.4 per square mile of grazing land.

About 10 to 12 thousand square miles are most productive irrigated or sub-irrigated lands, contained in oases and along the banks of the Nile. Crops of great value are grown under an elaborate irrigation system with primitive implements and agricultural methods (Figure 162). During the cooler part of the year, short season annual cool-weather crops are grown, while cotton, sugar cane, sorghum, and similar warm-weather crops grow well in the warmer portion of the year. Dates, citrus, vines, and many sub-tropical fruits and vegetables are grown.

The principal cool-weather crops are wheat, barley, and beans, and the principal warm-weather crops, maize, cotton, and rice.

About 373,000 square miles, 97 per cent of the total area, are unsuited to crop production and therefore suitable to grazing only. Of this there are about 98,000 square miles of desert which have no sustained forage value. After rains, plants spring up and may be of value as forage for a few days. About 275,000 square miles is grazing land of low carrying capacity.

The agricultural exports amount to $26,176 per square mile of agricultural land. They are chiefly cotton, cottonseed, onions, rice, maize, and cottonseed cake.

The population is 14,213,000 or an average density of 37 per square mile. If only land capable of crop production is considered the density is 1,420 per square mile.

ANGLO-EGYPTIAN SUDAN

This country is the largest of all the African colonies and has an area of 1,008,000 square miles (Figure 163). It is drained by the Nile to the north. The drainage of the upper White Nile, and the drainage from the Lado, through the Bahr el Ghazal join at Lake No. Above this lake on both rivers is one of the largest swamp areas in the world, mostly of papyrus, where a great part of the water, probably three-fourths, is lost by evaporation and transpiration. From the Ethiopian highlands, the Sobat, the Blue Nile, and the Atbara add about 89 per cent of the water which flows into the lower Nile. The water resources are greater than those of any other colony. Waters are impounded for irrigation in the region south and east of Khartoum. When the Blue Nile is in flood the White Nile is dammed back 250 miles above Khartoum by the flood waters.

In the northeast lies the Nubian desert; in the northwest the southern part of the Lybian desert. South of this desert in zonal belts the vegetation changes from desert to high grass and low tree savanna. Beginning at the north there are about 164,000 square miles of desert unsuitable to grazing because of the sparse vegetation. The desert shrub and desert grass occupy an equal area of 168,000 square miles

valuable for grazing but of very low carrying capacity. It forms a belt across the colony north of Khartoum. The acacia–desert grass savanna is also grazing land of low carrying capacity but much better than the desert shrub–desert grass, and valuable also for wood and gums. Less valuable as grazing land but more valuable for wood and gums are the 45,000 square miles of thorn forest. Here are some of the areas most productive of gum Arabic which is an important export and of which the colony is the chief source of the world's supply.

The acacia–tall grass savanna covers about 388,000 square miles, over a third of the total area. This is grazing land of high carrying capacity and valuable as warm-weather crop land. Somewhat similar as crop land and also valuable as grazing land and for timber is the dry forest of 17,000 square miles.

Only a small area of 42,000 square miles is of high grass–low tree savanna, especially valuable for warm-weather crop lands. Here are also values in timbers and shea butter (Figure 164). This area lies mostly adjacent to the Congo and French Equatorial Africa.

Land Use.—There are no great areas of true forest but about 62,000 square miles, 6 per cent of the total area, can be classed as woodland.

The grazing land of low carrying capacity amounts to 398,000 square miles or 39 per cent of the area. About 431,000 square miles, 43 per cent, is grazing land of high carrying capacity. The combined area of about 829,000 square miles, or 82 per cent of the total area, is suitable for cattle, sheep, and goats. The livestock production amounts to about 3,120,000 animal units composed of cattle, donkeys, sheep, goats, camels, horses, mules, and pigs. There are about 3.8 animal units per square mile. Wild animals are abundant in much of the area and along the upper Nile. The potentialities of domestic livestock production have by no means been approximated.

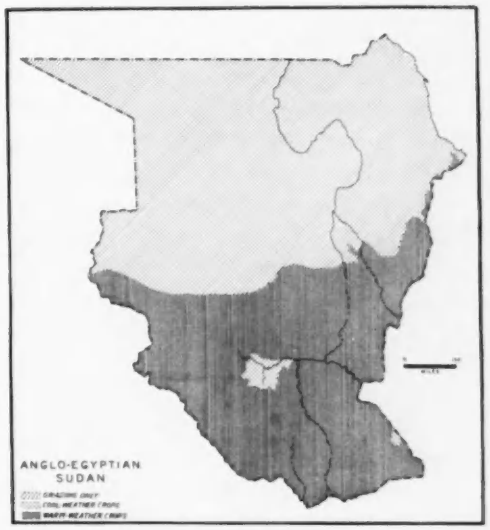

FIGURE 163.—The Anglo-Egyptian Sudan has an area of a little over 1,008,000 square miles. Along the Ethiopian border there may be as much as 1,000 square miles of cool-weather crop land. About 447,000 square miles are suitable for warm-weather crops and 560,000 square miles are suitable for grazing only.

Land Classification.—There are probably not over 1,000 square miles of cool-weather crop lands in the colony. In the north several million acres have been placed under irrigation on both the Blue and the White Nile. Here cool-weather crops are grown in winter. Cotton is a staple summer crop. Dates are especially important in the northern part of the colony.

The area for warm-weather crops is unusually great, amounting to 447,000 square miles, or 44 per cent of the total area. The principal crops are sorghum, millet, cotton, sesame, groundnuts, wheat, maize, barley, and beans.

About 56 per cent of the area, or 560,000 square miles, are unsuitable for crop production and suitable for grazing only. Of this about 164,000 square miles are of little or no value, leaving 398,000

square miles of grazing land of low carrying capacity suitable only to grazing.

The agricultural exports amount to about $53.00 per square mile of agricultural land and are chiefly cotton, cottonseed, hides, sesame, skins, cattle, dates, ivory, groundnuts, and gum Arabic.

The population is 5.5 per square mile, or if based on crop land only, about 12 per square mile.

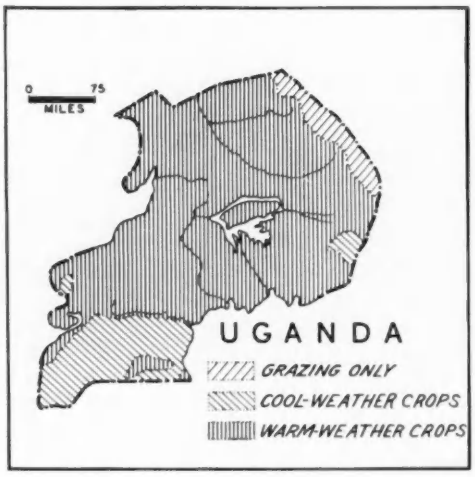

FIGURE 165.—Uganda has a land area of nearly 81,000 square miles. Of this area 17,000 square miles are suitable for production of cool-weather crops and 56,000 square miles for production of warm-weather crops. About 8,000 square miles are suitable for grazing only.

UGANDA

Uganda (Figure 165) with an area of 81,000 square miles lies on the equator and on the northwest shore of Lake Victoria which has a water level at 3,281 feet elevation and from which the Nile flows over a low escarpment to form Ripon Falls (Figure 166). The Nile flows through Lake Kioga, a papyrus swamp covering thousands of square miles. Mount Elgon on the southeast border and the Ruwenzori range in the southwest are the principal mountains.

The vegetation varies from the tropical rain forests of about a thousand square miles such as the Bugoma and Budonga forests east of Lake Albert, the temperate rain forests of about a thousand square miles such as are found on Mount Elgon and the Ruwenzori range, through the grassland types. The high grass–low tree savanna covers about 37,000 square miles of the central part of the colony and includes the large papyrus swamp which surrounds Lake Kioga. The acacia–tall grass savanna of 15,000 square miles lies farther north. Along the Kenya border in the northeast a more open type of about 8,000 square miles is of acacia–desert grass savanna. In the north and east there are also many thickly wooded areas of dry forest of about 3,000 square miles valuable for timber and gums. The mountain grassland of the southwest of about 16,000 square miles is excellent grazing land and suitable for cool-weather crops.

FIGURE 164.—Shea butter is produced in the savanna country. The nuts of the shea tree (*Butyrospermum parkii*) are gathered, roasted, ground, and then boiled to separate the butter. Here under a storage basket used for shade the nuts already roasted are broken up and ground on a grinding stone. The black paste looks like asphalt. Moku, Anglo-Egyptian Sudan.

Land Use.—The forests occupy about 2,000 square miles, about 2.5 per cent of the area, and furnish timber of unusual value. The woodlands cover

FIGURE 166.—Ripon Falls marks the source of the Victoria Nile. The water at the left is Lake Victoria and the water at the right is the Victoria Nile. Jinja, Uganda.

about 3,000 square miles, less than 4 per cent, valuable for timber, wood (Figure 167), and gums. There are in addition resources from the savanna area which furnish valuable timber trees such as iroko (m'vule) (Figure 168) and such economic products as shea butter.

About 71,000 square miles, 87 per cent, is grazing land of high carrying capacity, some as good as any in Africa. Grazing land of low carrying capacity covers not over 8,000 square miles, 10 per cent of the area. Almost the total area of 79,000 square miles is suitable for sheep and goats. Cattle find about 31,000 square miles, 38 per cent, unusually favorable. Here are produced cattle, goats, sheep, and donkeys. The total animal units amount to about 2,471,000, 31 per square mile of grazing land. Wild animals are abundant over much of the area and ivory is an important export product.

Land Classification.—Not much of the cool-weather crop land has been developed, since under natural conditions most of it is excellent grazing land and is occupied by a cattle raising people. This area of about 17,000 square miles, 21 per cent of the total area, produces under European supervision coffee and tea, and by natives bananas, beans, peas, coffee, potatoes, and wheat. Warm-weather crop land is far more extensive and amounts to about 56,000 square miles, 69 per cent of the total area. A great variety of crops can be grown but two crops stand out: first, bananas as a food crop; and second, cotton as a money crop.

The chief crops grown by Europeans are rubber, tobacco, cotton, and maize. But this production is very small as compared with the native production of bananas, cotton, millet, sweet potatoes, sorghum, manioc, sesame, beans, maize, peas, groundnuts, rice, sugar cane, tobacco, chillies, and rubber. The northern portion of the colony has a drier climate and is especially adapted to such crops as sorghum, millet, manioc, and cotton. Here sorghum and manioc become food crops instead of the banana which is the food crop of the south and central portion. The fields of banana are as characteristic of Uganda as fields of corn are charac-

FIGURE 167.—Wood for Nile steamers is not easy to procure. Natives collect the wood at specified points and pile it up as cord wood to dry. It is shown in the back. Three dugout canoes are in the foreground and papyrus swamp is shown at the left. Between Atura and Masindi Port on the Victoria Nile.

teristic of Illinois. In the north, grains are stored by order of the government against periods of drought and famine. The natives with plenty of food crops have been induced to produce cotton as a money crop.

Very little of the land of Uganda is suitable for grazing only, but a part of the drier northeast portion of about 8,000 square miles, 10 per cent of the area, can be so designated.

The exports from Uganda are cotton, cottonseed, coffee, hides, skins, rubber, chillies, sesame, and ivory, and amount to about $281.00 per square mile of agricultural land.

The population density is about 36 per square mile, or if only agricultural land is considered, about 47 per square mile. There are about 1,700 natives to one European.

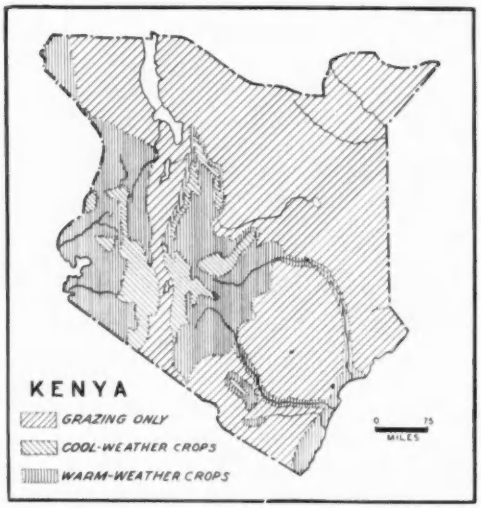

FIGURE 169.—Kenya has a land area of nearly 220,000 square miles. About 17,000 square miles are suitable for the production of cool-weather crops and 39,000 square miles for production of warm-weather crops. The remaining 164,000 square miles are suitable for grazing only.

KENYA

Kenya is one of the most varied and interesting of the African colonies (Figure 169). It lies directly on the equator, and has an area of 22,000 square miles. Due to great changes in elevation and in moisture conditions, it affords great differences in climate and this is reflected in the vegetation. The elevation varies from sea level to 17,040 feet on Mount Kenya. The highland is separated into eastern and western highlands by the Rift Valley which is partially filled in places by volcanic cones and lava flows. The north and east is a desert region.

FIGURE 168.—Savanna trees in fields of bananas and sweet potatoes. The large tree is the Mvule (*Chlorophora excelsa*) which extends across to West Africa and is known in the European trade as Iroko. Iganga, Uganda.

The vegetation includes less than a thousand square miles of mangrove forest, valuable because of the termite and mussel resistant qualities of the wood, and as tan bark.

The tropical or lowland forest areas of about a thousand square miles are scattered along rivers and at low elevation. Temperate rain forests often replaced by crop land are estimated at about 12,000 square miles, chiefly in the highlands west and east of the Rift Valley. Dry forests of about 4,000 square miles and thorn forests of about 12,000 lie mostly in the north. The acacia–tall grass savanna occupies about 34,000 square miles, or about 15 per cent of the total area. It is

open grazing land, usually valuable for wild animals, domestic livestock, or for cotton and sorghum production. The mountain grassland of about 5,000 square miles is closely similar to temperate rain forest as cool-weather crop land and is also ideal grazing land. The acacia–desert grass savanna is grazing land only, and furnishes wood and gums. It occupies about 43 per cent of the area, 94,000 square miles, in the northern and eastern part of the colony. A more arid type, the desert shrub–desert grass occupies about a fourth of the colony, 57,000 square miles, along the Somaliland border. It is grazing land of low carrying capacity.

FIGURE 170.—Dry or nearly dry beds of rivers furnish water holes for domestic and wild animals in much of the semi-desert country. Water is shown standing in shallow pools. Dum palm, a branching palm of value as food and for vegetable ivory, is shown growing along the side of the sand river. The tracks in the sand are elephant, rhinoceros, giraffe, zebra, oryx, and hundreds of other animals. Merile, Kenya.

Land Use.—About 14,000 square miles, 6.4 per cent, may be called forest land. The actual forests are much less than this. A large amount of timber and forest products is produced on savanna land and woodlands. The latter occupy about 16,000 square miles, 7.3 per cent, valuable for wood, gums, and grazing.

Grazing land of high carrying capacity covers about 43,000 square miles, nearly a fifth of the total area. Some of this is unexcelled. Grazing land of low carrying capacity covers nearly three-fourths of the area, about 163,000 square miles. The total area of grazing land, 206,000 square miles, 94 per cent, is suitable for sheep and goats and about 185,000 square miles, 84 per cent, is suitable for cattle. On this area Europeans produce cattle, sheep, pigs, horses, goats, donkeys, and mules, and the natives produce cattle, goats, sheep, camels, donkeys, and a few horses and mules. About 4,216,000 animal units are produced, about 20 per square mile of grazing land. Here are also produced great numbers of wild animals (Figure 170), and the revenue from hunting licenses is an important item of income to the colony. Here are probably the most famous hunting grounds in the world noted both for quantity and for variety of big game.

Land Classification.—Cool-weather crop land under the equator at an elevation of about one mile amounts to about 17,000 square miles, about 8 per cent of the total area. This is of great importance to the agriculture of the

colony, for here Europeans grow the crops they are accustomed to grow and also cool-weather tropical crops of great value. Europeans produce here chiefly sisal (Figure 171), coffee, wheat, barley, tea, flax, and other temperate crops. The natives produce vegetables and food crops and beans, peas, root crops, bananas, wattle, vegetables, and wheat. Almost any temperate crop can be grown here. Warm-weather crop land is much more extensive and amounts to about 18 per cent of the total area, 39,000 square miles. Here are produced such crops as maize, sugar cane, and coconuts, while the natives produce chiefly sorghum, millet, maize, sesame, coconuts, sugar cane, groundnuts, raphia, and cotton.

Land suitable for grazing only covers about 163,000 square miles. Most of this is good grazing land of low carrying capacity, suitable for domestic animals and game animals. It occupies three-fourths of the colony and lies mostly in the east and north.

The agricultural exports are chiefly coffee, sisal, hides, skins, maize, wheat, wattle, groundnuts, sesame, potatoes, and sugar, and amount to about $212.00 per square mile of agricultural land.

The population density is about 13 per square mile, or if based on amount of agricultural land, 53 per square mile. There are about 234 natives to one European.

ZANZIBAR

Here are included the two islands Zanzibar and Pemba with a combined area of about 1,020 square miles. Zanzibar lies at 6 degrees and Pemba at 5 degrees south of the equator. They are coralline islands and rise only a few feet above sea level.

Mangrove forests, especially on Pemba, amount to probably 30 square miles and there is also a small amount of tropical forest of about 20 square miles. There is, therefore, about 50 square miles, or 5 per cent, of forest valuable for timber and tan bark.

The larger part of the area could be classed as originally being acacia–tall grass type, amounting to about 570 square miles, or 56 per cent of the area. About 400 square miles are classified as rocky or shallow soil, about 39 per

FIGURE 171.—Sisal is an important fiber crop. These are drying frames used to dry the fiber after it has passed through the mill. Voi, Kenya.

FIGURE 172.—Coconut is one of the most useful plants of the tropical coast regions. It furnishes drink, food, oil, fiber, and building material. Here is shown primitive method of manufacturing large ropes from coconut fiber. Zanzibar.

cent of the area. Some of this land is useful both for grazing and crop production.

Except for the forests the entire area of 970 square miles is grazing land. Here are produced cattle, goats, donkeys, and a few horses, mules, and camels. The production amounts to about 37,000 animal units, 38 animal units per square mile of grazing land. In this regard it ranks high as a pastoral country along with such colonies as Tunis, Swaziland, Madagascar, and Uganda.

Land Classification.—About 690 square miles, 68 per cent, are suitable for warm-weather crops. Here is produced the world's supply of cloves. Next in importance are coconuts exported as copra. Cloves are produced on the deep, red loams and clays, and coconuts on the deep sandy soils. Coconuts furnish food, drink, fuel, fibre (Figure 172), and building material, and one of the valuable exports, copra. Tropical fruits, manioc, pineapple, sweet potatoes, groundnuts, and a great variety of vegetables are grown, mostly for local consumption. Manioc (cassava) is the principal food plant (Figure 173).

Lands incapable of crop production are the areas of saline mud in the mangrove forests and the bare rock areas. These probably amount to only about 330 square miles. Except for the mangrove forest, 300 square miles, about 29 per cent of the total area, is suitable for grazing only.

The principal agricultural exports are cloves and copra, the total amounting to $8,214.00 per square mile of agricultural land.

The population is about 212 per square mile, or if based on agricultural land only, about 314 per square mile. There are about 802 natives to each European.

TANGANYIKA

This large mandated colony of 366,000 square miles lies between the equator and 12 degrees south on the east coast opposite Zanzibar (Figure 174). Historically this is an important location for much of early east African slave trade and travel started with Zanzibar as a base. In general terms most of the area has an elevation above 2,000 feet and only a strip along the east coast lies below that elevation. The produc-

FIGURE 173.—Markets of Zanzibar offer a great variety of vegetables and fruits for sale or exchange. Here are shown breadfruit, manioc (cassava), lemon, and many types of bananas. In the background are papaya, jack fruit, betelnut, rambutan, coconut, oranges, limes, citron, guava, mango, rose apples, sapota, avocado, and almost everything one can think of in the way of tropical vegetables and fruits. Zanzibar.

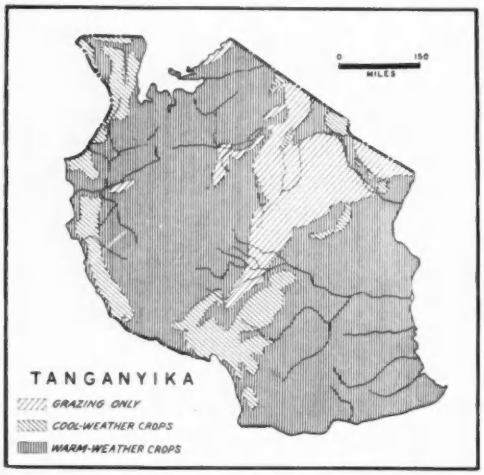

FIGURE 174.—Tanganyika has an area of a little over 366,000 square miles. About 56,000 square miles are suitable for cool-weather crops, 243,000 square miles for warm-weather crops, and 67,000 square miles for grazing only.

tive highlands are mostly in the southwest and western portion. One of the world's most attractive mountains, Kilimanjaro (Figure 175), lies near the Kenya border and reaches an elevation of 19,720 feet.

This varied topography accompanied by variation in rainfall produces many types of vegetation. Mangrove forests of about a thousand square miles lie along the coast and produce tan bark and construction timber. About 4,000 square miles of tropical rain forest is found mostly along the rivers in the eastern and southern part. The temperate rain forest of about 6,000 square miles is mostly in the northeast and the highlands of the south. Similar in climate but much more valuable as grazing lands and probably derived largely by the destruction of temperate rain forest is the mountain grassland of about 50,000 square miles.

The largest areas are characterized by acacia–tall grass savanna and amount to about 164,000 square miles, 45 per cent of the area. This is grazing land and is also suitable for warm-weather crops, especially cotton and sorghum which require a dry period for ripening. Differing little from this in crop potentiality but more likely to harbor tsetse fly is the dry forest of about 75,000 square miles. This is valuable for wood and small timber. Thorn forests cover about 36,000 square miles, mostly along the coast and in a strip in the central portion of the colony valuable for wood and gum but too dry for crop land. The acacia–desert grass, similar in lacking crop producing potentialities but somewhat better as grazing land, covers about 28,000 square miles. There are salt deserts totaling probably less than 2,000 square miles.

Land Use.—The forests total about 11,000 square miles, about 3 per cent of the colony. The woodlands cover about 111,000 square miles, nearly a third of the area. Combined, these occupy a third of the territory and produce wood, construction timbers, tan bark, gums, and ebony-like and mahogany-like timber. Some of the forest products are produced in the savanna country.

Grazing land of high carrying capacity amounts to about 289,000 square miles, 79 per cent of the total area. The land of low carrying capacity is about 66,000 square miles in extent, 18 per cent of the area. Together these amount to 97 per cent of the area, 355,000 square miles of grazing land suitable for sheep and goats. Of this area about 202,000 square miles, 55 per cent, is suitable for cattle. On the grazing lands are produced cattle, goats, sheep, donkeys, pigs, and a few horses, mules, and camels. The total amounts to about 5,925,000 animal units or about 17 per square mile of grazing land. Game animals are important and excellent hunting areas lie in many parts of the territory.

Land Classification.—Cool-weather

crop land amounts to about 56,000 square miles, about 15 per cent of the area, and is widely scattered. Here are produced chiefly coffee by Europeans, and bananas, coffee, wheat, eleusine, pennisetum, and yams by natives. Here more than in other colonies the natives have been encouraged to produce coffee and exceptionally fine plantations are found in the regions about Bukoba and Moshi. Here can be produced almost any cool-weather crop (Figure 176) such as the fruits, cereals, and food plants grown in temperate countries. Warm-weather crop land of about 243,000 square miles, or nearly two-thirds of the area, produces under European supervision chiefly sisal, maize, and coconuts. Natives produce millet, maize, beans, peas, sisal, manioc, cotton, rice, sweet potatoes, groundnuts, sesame, coconuts, copra, sugar cane, rubber, tobacco, potatoes, kapok, oil palm, mango, and many other food crops.

The land incapable of crop production or suitable for grazing only amounts to about 67,000 square miles, about 18 per cent of the total area. Most of it is grazing land of low carrying capacity.

The principal agricultural exports are sisal, coffee, cotton, hides, copra, groundnuts, sesame, rice, skins, beeswax, cotton seed, ghee, and millet. The value amounts to about $59.00 per square mile of agricultural land.

The population density is 13 per square mile, or on the basis of agricultural land, 16 per square mile. There are about 724 natives to one European.

URUNDI AND RUANDA

This is a small highland north and east of Lake Tanganyika of about 21,000 square miles. There is a small amount of lowland above Lake Tanganyika which has a water level of 2,590 feet. This is occupied by acacia–tall grass savanna covering about 3,000 square

FIGURE 175.—Kilimanjaro rises to 19,720 feet, the highest point in Africa. The view here is from the maize fields near Moshi and shows Kibo, the western snow-covered summit. Moshi, Tanganyika.

miles, or 14 per cent of the area. There are a few square miles in temperate rain forest in protected slopes in the mountains and on the escarpment. The mountain grassland of 16,000 square miles, more than three-fourths of the total, is excellent grazing land and cool-weather crop land. It occupies a mountainous plateau (Figure 177) populated by Watusi, a cattle-raising aristocratic people of Hemitic origin and probably descended from the shepherd kings of Egypt.

Along the rivers, even on the highlands, papyrus swamps occupy large areas, probably amounting to nearly 2,000 square miles.

The whole area is grazing land suitable for sheep, cattle, and goats, and is of high carrying capacity. Cattle raised by the Watusi are regarded as nearly sacred. Each animal has a name and they are often sorted as to color. The variety has unusually large horns. They are milked and bled regularly since milk and fresh blood constitute the staple food of the Watusi men. Cattle, sheep, and goats are produced. The number of animal units amounts to 903,000, 43 per square mile of grazing land. Livestock is the most important native industry.

Land Classification.—Cool-weather crop land amounts to 16,000 square miles 76 per cent of the area. Here are produced bananas, beans, peas, eleusine, wheat, potatoes, and coffee. The warm-weather crop land, occupying 3,000 square miles, 14 per cent of the area, produces chiefly sorghum, maize, manioc, oil palm, groundnuts, colocasia, rice, sugar cane, and cotton. The com-

FIGURE 176.—Luxuriant crops are produced on the sides of the central African mountains. Here are shown rice, bananas, papaya, sugar cane, okra, maize, pumpkins, and groundnuts. Moshi, Tanganyika.

FIGURE 177.—The highlands of central Africa are grazing lands and suited to the production of cool-weather crops. This mountainous plateau is covered with mountain grassland and cool-weather crops. Rusoka, Urundi.

plete list would include also sweet potatoes, yams, cucurbits, castor beans, and many other vegetables.

The principal agricultural exports are hides, skins, palm kernels, cotton, coffee, palm oil, and ghee (Figure 178). These amount to about $18.00 per square mile of agricultural land.

There are about 71 people per square mile, or, if the swamps are eliminated, 79 per square mile of land capable of agricultural production. There is probably only one European to three to five thousand natives.

NYASALAND

This small colony of about 38,000 square miles occupies the highlands west of Lake Nyasa and around the southern shore and extends down the Shire Valley (Figure 179). The lake level is about 1,645 feet and the highlands rise to over 8,000 feet. The whole colony receives sufficient rainfall to produce cultivated crops.

There are about a thousand square miles of temperate rain forest on protected slopes of the higher mountains. Most of the higher lands are mountain grassland, excellent year-long grazing lands and suitable for the production of cool-weather crops. This area is about 6,000 square miles or about 16 per cent of the area.

The acacia–tall grass savanna occupies about 31,000 square miles or nearly 82 per cent of the area. This is valuable as grazing land and for the production of warm-weather crops. Parts of it support a rather heavy growth of trees of value for wood and timber. In fact, a large part of this area could be classed as dry forest.

Land Use.—The forest land probably does not exceed a thousand square miles. Here there enters from the south

the Mlanje cypress, a valuable timber tree. Woodland of about 10,000 square miles, a fourth of the area, made up of dry forest and scattered savanna trees, produces firewood, poles, mahogany-like and ebony-like cabinet woods. Many forests have been planted to make up for timber deficiency. Almost the whole area of about 37,000 square miles is grazing land of high carrying capacity. There are no areas of low carrying capacity land.

Sheep and goats graze the whole area but cattle are often limited by the denser cover and probably use only about 21,000 square miles, a little over half of the area. Here are produced cattle, sheep, pigs, donkeys, and a few goats, horses, and mules by Europeans. Natives produce cattle, pigs, goats, and sheep. The total production amounts to about 225,000 animal units, 6.1 per square mile of grazing land.

Land Classification.—About 14,000 square miles, or 37 per cent, is suitable for the production of cool-weather crops. These are chiefly timber, tea, coffee, and wheat by Europeans, and wheat, beans, and a great variety (Figure 180) of food crops by natives. Warm-weather crop land amounts to about 24,000 square miles, or 63 per cent of the area. The principal crops grown by Europeans are tobacco, sisal, maize, millet, rubber, cotton, and groundnuts. Natives produce chiefly cotton, tobacco, maize, groundnuts, rice, manioc, and food crops. Most of the rice is produced along the shore of Lake Nyasa. Most of the cotton is produced along the northwest shore and along the Shire River. Tobacco is a money crop for the natives since it can easily be transported to market.

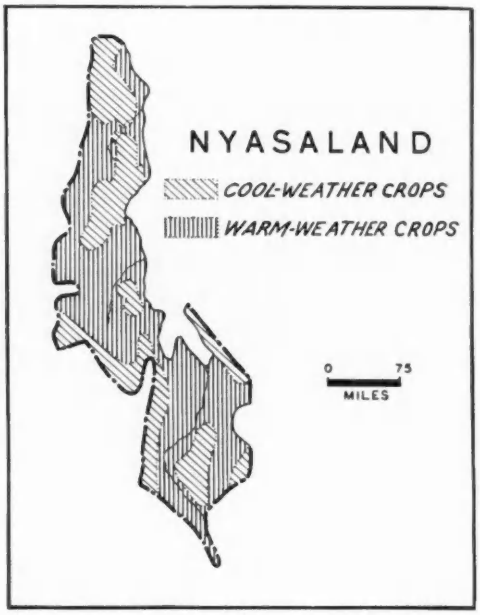

FIGURE 179.—Nyasaland has a land area of nearly 38,000 square miles. About 14,000 square miles are suitable for cool-weather crops and 24,000 square miles are suitable for warm-weather crops.

There is no land to be classified as unsuitable for crop production on the basis of rainfall in Nyasaland.

The principal agricultural exports are tobacco, tea, cotton, rubber, coffee, cottonseed, hides, skins, ivory, and beeswax. The value of these exports amounts to $75.00 per square mile of agricultural land.

Nyasaland has a population density of 28 per square mile and there are 701 natives to one European.

FIGURE 178.—Butter is wrapped in banana fiber and offered for sale. It is then melted and shipped in cans as ghee. Nyanza, Urundi.

NORTHERN RHODESIA

This large block of land of 288,000 square miles in central South Africa is far from navigation and relatively uniform in topography (Figure 181). It drains largely into the Zambezi except for a relatively small drainage in the north which finds its way through Lake Tanganyika and Lake Bangweolo to the Congo. Most of the colony lies at an elevation of 3,000 to 4,500 feet, but the highlands of the north exceed 5,000 feet.

Temperate rain forests of about 11,000 square miles, only about 4 per cent of the area, are potential cool-weather crop land and are confined to the northern part of the colony. Mountain grassland of 6,000 square miles, 2 per cent of the colony, is also in the northern part and is valuable grazing land and cool-weather crop land.

A large swamp area of about 10,000 square miles is valuable for certain types of grazing and productive of game and other wild life. Otter are especially abundant in the marshes about Lake Bangweolo. Lechwe and sitatunga are two antelopes which live in the marshes and the buffalo and elephant are also often found in them.

Dry forest covers 258,000 square miles, nearly 90 per cent of the area. Open grassland areas of acacia–tall grass land add an additional 3,000 square miles of land suitable for warm-weather crops and grazing land of high carrying capacity.

FIGURE 180.—Cabbage with good solid heads is here shown growing with roses, eucalyptus, and bananas. Blantyre, Nyasaland.

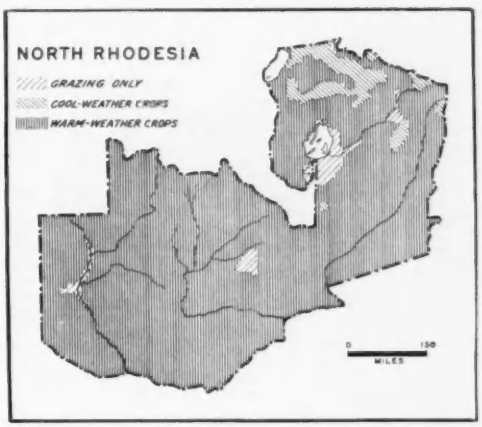

FIGURE 181.—Northern Rhodesia has an area of nearly 288,000 square miles. Of this area 17,000 square miles are suitable for cool-weather crops, 261,000 square miles for warm-weather crops, and 10,000 square miles for grazing only.

Land Use.—Forests occupy about 11,000 square miles, about 4 per cent of the area. Over 258,000 square miles, 90 per cent of the area, might be classified as woodland. Wood and timber could be marketed from here if demand should overcome difficulties of transportation. There are about 277,000 square miles of grazing land of high carrying capacity, 96 per cent of the total area. This is all suitable for goats and sheep, and about 158,000 square miles, 55 per cent of the total area, is suitable for cattle.

This grazing area produces under European management cattle, sheep, pigs, and a few horses, mules, and donkeys. The natives produce cattle, goats, sheep, and pigs. The total production in animal units is 641,000, or 2.3 per square mile. This is very low when compared with other colonies, only about eight having as low a

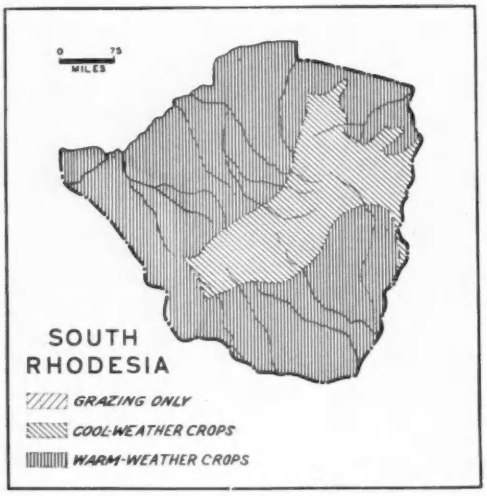

FIGURE 182.—Southern Rhodesia has an area of 149,000 square miles. Of this area 40,000 square miles are suitable for cool-weather crops and 109,000 suitable for warm-weather crops.

domestic animal population per square mile of grazing land.

The principal agricultural exports are tobacco, hides, skins, maize, wheat, ivory, cattle, wood, and pigs. The exports amount to about $2.40 per square mile of agricultural land. Here again Northern Rhodesia ranks near the bottom.

The population density is 4.6 per square mile, or, on the basis of land with agricultural potentiality, 4.7 per square mile. This is also very low. There are about 130 natives to one European.

SOUTHERN RHODESIA

Southern Rhodesia, with an area of 149,000 square miles, lies between Portuguese East Africa and the Zambezi River (Figure 182). Tourist interest centers in the Victoria Falls of the Zambezi in the extreme western portion. The country varies in elevation. The higher lands extend from four to five thousand feet elevation across the central part of the colony and the drainage is northwest to the Zambezi and southeast to the Limpopo and Sabi rivers.

The vegetation is chiefly acacia–tall grass savanna of about 104,000 square miles, about 70 per cent of the total area. This is good grazing land of high carrying capacity, and at lower elevation is excellent maize, sorghum, and cotton country. At higher elevation small grains and deciduous fruits are produced.

On some of the higher plateaus tall grass covers probably 5,000 square miles similar to the grasslands of the Transvaal and Orange Free State. This is especially valuable for cool-weather crops.

Dry forests on the lower lands of the north and west, along the Zambezi River and Bechuanaland border, amount to about 40,000 square miles, about 27 per cent of the total area. Here are values in grazing land, wood, and small timber. Warm-weather crops can be produced over much of the area. Some of the western portion is almost too arid for crop production.

Land Use.—Except for small patches of temperate rain forest along the eastern border there is no strict forest area in Southern Rhodesia. About 40,000 square miles, 27 per cent of the total area, can be classified as woodland. Here are produced quantities of timber and wood such as mopane, and Rhodesian teak and many other trees of special value (Figure 183). Soft woods are being planted to make up for their shortage in the native timber. Much of the timber and wood comes from the savanna.

The total area of 149,000 square miles, is grazing land of high carrying capacity. All of this land is suitable for sheep and goats but probably only about half, or 72,000 square miles, is suitable for cattle since they are shut out of lower areas of denser vegetation by tsetse fly.

On these grazing lands cattle stand out as most important. Here Europeans produce cattle, sheep, donkeys, pigs, goats, horses, and mules. Native production far exceeds European and is chiefly cattle, goats, sheep, donkeys, pigs, and a few horses and mules. The total production in animal units is 2,728,000, 18 per square mile of grazing land, which includes the whole area.

Land Classification.—About 40,000 square miles, 27 per cent, may be considered capable of producing cool-weather crops. In most of this area during the warmer portion of the year warm-weather crops can be grown and cool-weather crops are grown during the winter. Here Europeans produce wheat, sunflowers, oats, beans, coffee, and potatoes, as well as deciduous fruits such as peaches, apples, and plums.

Warm-weather crop land amounts to about 109,000 square miles, 73 per cent of the area. Here are produced in winter some of the cool season crops, but it is ideal for such warm-weather crops as maize, sorghum, and groundnuts. European production is chiefly maize, tobacco, groundnuts, and eucalyptus. Natives produce millet, sorghum, maize, rice, cowpeas, groundnuts, sweet potatoes, yams, manioc, melons, and many other food crops. The country should be productive of cotton but this crop has not yet been developed, due at least partly to low prices and partly to attacks of a leaf-sucking insect known in South Africa as a jassid. It is also possible that cattle and maize are a better combination and that cotton may be more useful in areas where cattle are less important.

The agricultural exports are principally tobacco, cattle, maize, hides, citrus fruits, butter, maize meal, wheat flour, eggs, skins, groundnuts, and pigs, amounting to $73.00 per square mile of agricultural land.

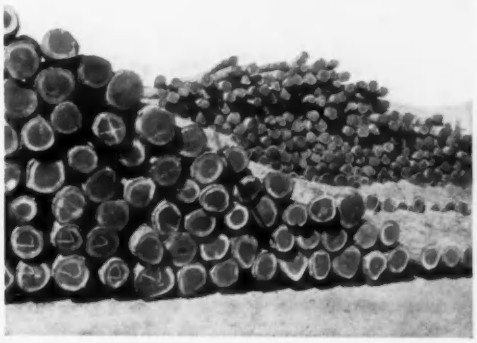

FIGURE 183.—Logs of mopane (*Copaifera mopane*) shipped from Rhodesia to Kimberley. It is especially valuable for mine timbers. Kimberley, Transvaal.

The population is about 7.6 per square mile and there are about 21 natives to one European.

PORTUGUESE EAST AFRICA

Portuguese East Africa occupies the coast country of East Africa from Tanganyika on the north to Natal on the south, and covers about 293,000 square miles (Figure 184). It extends inland about 250 miles along the Zambezi River. The coast lands and most of the southern part are less than a thousand feet in elevation. In the northwest along Lake Nyasa and the Nyasaland border and along the Southern Rhodesian border the elevation may reach 3,000 to 5,000 feet.

Along the coast mangrove probably occupies a thousand square miles valuable as timber and for tan bark. Along the river bottom in the warmer and damper part of the colony there are scattered about a thousand square miles of tropical rain forest.

Temperate rain forest limited to protected areas on the higher mountains probably covers about 3,000 square miles and furnishes some of the lighter timber.

About half of the colony, 142,000 square miles, is covered with dry forest

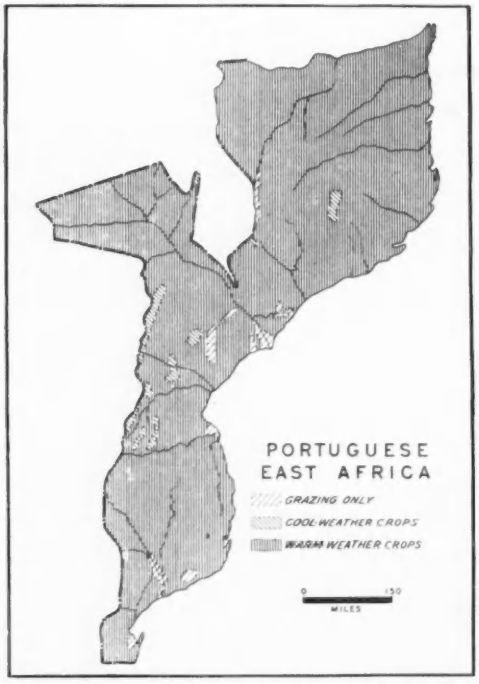

FIGURE 184.—Portuguese East Africa has an area of a little over 293,000 square miles. About 4,000 square miles are suitable for cool-weather crops, 285,000 square miles for warm-weather crops, and 4,000 square miles for grazing only.

valuable because of the great amount of landolphia rubber which grows there and also for ebony- and mahogany-like timber and woods. This area is also valuable for grazing land and for the production of warm-weather crops.

Acacia–tall grass savanna occupies an area similar in extent, is somewhat better grazing land especially for cattle but less valuable for rubber and wood. A small area of about one thousand square miles is tall grass land, excellent grazing for cattle and suitable for cool-weather crops. An area of about 3,000 square miles of marsh grass is especially valuable as a wildlife area.

Land Use.—About 5,000 square miles of forest produce timber. To this may be added 142,000 square miles of woodland, the total equaling half of the area of the colony. These are valuable for rubber, timber, wood, tan bark, and cashew nuts.

About 288,000 square miles, 98 per cent of the colony, is grazing land of high carrying capacity. Cattle are shut out of the denser portions and probably best adapted to only about 72,000 square miles, about a fourth of the area. The areas to be used by cattle are continually being extended in Africa by more adaptable breeds and better control of disease and this estimate is probably too low. The total area available to grazing produces under European management cattle, pigs, goats, sheep, and a few donkeys, mules, and horses. Natives produce cattle, goats, pigs, donkeys, sheep, and a few mules and horses. The total production is 528,000 animal units or 1.8 per square mile of grazing land. This is even lower than Northern Rhodesia.

Land Classification.—A very small area, about 4,000 square miles, is suitable for cool-weather crops such as coffee, fruits, and vegetables. About 285,000 square miles, 97 per cent of the total area, is suitable for warm-weather crops. Here are produced, by Europeans chiefly, coconuts (Figure 185), sisal, maize, tobacco, sugar cane, pineapple, cotton, and groundnuts. Native production is chiefly maize, millet, groundnuts, sweet potatoes, beans, rice, manioc, and tobacco.

The principal agricultural exports are groundnuts, copra, sugar, sisal, millet, and bananas. These total about $1.30 per square mile of agricultural land.

The population density is about 12 per square mile and there are about 98 natives to one European.

MADAGASCAR

Madagascar is a large island of 241,000 square miles, lying east of Africa and is separated from the main-

land by a channel 240 miles wide (Figure 186). The island is traversed by a highland which sets off on the east a more tropical portion with higher rainfall. About a third of the island is above 2,000 feet in elevation.

The vegetation ranges from tropical rain forest along the east shore to acacia–desert grass savanna along the southwest. Mangrove forests of probably a thousand square miles lie mostly on the west coast of the island. About 41,000 square miles of tropical rain forest lie along the east shore. Here are valuable timber trees and the land is valuable for the production of warm-weather crops. On the eastern crest of the highlands a temperate rain forest of about 18,000 square miles is of value as timberland and for the production of cool-weather crops. This forest occupies more land in the north and thins out toward the south.

The acacia–tall grass savanna of 170,000 square miles and the small areas of dry forest of about 4,000 square miles are grazing lands of high carrying capacity and warm-weather crop lands suited to warm-weather cereals and cotton. These constitute 73 per cent of the total area of the island. Acacia–desert grass savanna, of 6,000 square miles, is grazing land of low carrying capacity. A marsh grass land of about one thousand square miles completes the area.

Land Use.—Madagascar was well supplied with forest, amounting to about 60,000 square miles, 25 per cent of the total area. Here are tropical and temperate forest timbers of many kinds including the mahogany- and ebony-like timbers and the yellowwoods of value as cabinet woods and as timber and construction material. Probably about half of the tropical rain forest has been converted into crop lands especially in the north and the southeast.

Woodlands of about 4,000 square miles produce timber and wood and to this should be added the production of forest products on savanna lands.

FIGURE 185.—A young coconut plantation. Beira, Portuguese East Africa.

FIGURE 186.—Madagascar has an area of about 241,000 square miles. About 18,000 square miles are suitable for cool-weather crops, 215,000 for warm-weather crops, and 8,000 for grazing only.

Grazing lands of high carrying capacity occupy about 174,000 square miles, 72 per cent of the area. The low carrying capacity grazing land occupies about 6,000 square miles of semi-arid land. Practically the total grazing area is suitable for sheep and goats, but cattle are less adapted to the dry forest area. On the total grazing area of 180,000 square miles, three-fourths of the total area, cattle, pigs, goats, and a few horses, donkeys, and mules are produced. The total production of animal units amounts to 7,040,000, 39 per square mile of grazing land.

Land Classification.—Cool-weather crop land amounts to about 18,000 square miles, a little over 7 per cent of the area. Here are produced chiefly coffee and potatoes. Warm-weather crop land amounts to about 215,000 square miles, 89 per cent of the total area. A large portion of this is still grazing land although much of the land is now cultivated. This is especially true in the north and along the southeast shore, where most of the land was tropical rain forest. The principal crops are rice, manioc, vanilla, and cloves grown by Europeans, and rice, manioc, maize, vanilla, cloves, and tobacco by natives.

Land incapable of crop production and suitable for grazing only occupies only about 6,000 square miles, 2.5 per cent of the total area. It is not an important part of the grazing resource of the colony.

The chief agricultural exports are vanilla, hides, coffee, peas, manioc, and beef. The exports amount to about $54.00 per square mile of agricultural land.

The population density is about 15 per square mile and there are about 122 natives to one European.

BASUTOLAND

Basutoland is a small highland of nearly 12,000 square miles lying at the headwaters of the Orange River between the Orange Free State on the north, Natal on the east, and the Cape of Good Hope on the south (see Figure 189). The Drakensberg Mountains forming the east boundary rise to 12,000 feet in elevation. Most of the country is between 5,000 and 10,000 feet elevation.

It is tall grass country, suitable for the production of cool-weather crops. There is very little wood. Much of the land is too rough for crop production but is used for grazing.

There are no European landowners since the land is operated under a native communal system. Europeans own and graze a few cattle, sheep,

horses, mules, and goats. The natives produce cattle, sheep, goats, horses, donkeys, and a few mules. The total prduction of animal units is higher than anywhere else in Africa and amounts to about 1,291,000 animal units, 106 per square mile of grazing land. The country is undoubtedly overstocked.

The principal crops grown are wheat, maize, Kaffir corn, beans, pumpkins, and melons.

The exports are wool, mohair, wheat, wheat flour, Kaffir corn, maize, maize meal, hides, skins, and cattle. The value of exports amounts to about $411.00 per square mile.

There are about 42 inhabitants per square mile and 309 natives to one European.

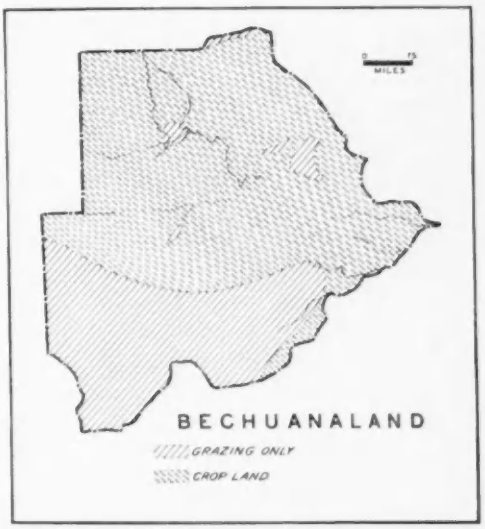

FIGURE 187.—Bechuanaland has an area of 275,000 square miles. About 175,000 square miles are suitable for warm-weather crops, and 100,000 square miles for grazing only.

SWAZILAND

This area of less than 7,000 square miles lies between the Transvaal and Portuguese East Africa (see Figure 189). It ranges from low veldt at about 1,000 feet elevation to the bush veldt at 2,000 feet, and to the high veldt which rises to over 4,000 feet.

While there are considerable differences in vegetation, the whole area falls in the acacia–tall grass type, suitable for grazing and for warm-weather crop production.

Grazing is an important industry. Europeans produce cattle, sheep, donkeys, goats, pigs, horses, and mules, and the natives produce cattle, goats, sheep, donkeys, horses, and a few mules. The total production amounts to about 246,000 animal units, 35 per square mile.

The crop land is warm-weather crop land, with cooler areas at higher elevation. Europeans produce maize, cotton, Kaffir corn, tobacco, and beans, and the natives produce chiefly maize, Kaffir corn, fruits, and vegetables.

The agricultural exports are chiefly cattle, tobacco, hides, cotton, and wattle, and the value is about $131.00 per square mile.

The population density is about 17 per square mile and there are 50 natives to one European.

BECHUANALAND

Bechuanaland occupies about 275,000 square miles in the center of South Africa and is bounded on the south and southeast by the Union of South Africa, on the northeast by Southern Rhodesia, and on the north and west by Southwest Africa (Figure 187). It lies at an elevation of a little over 3,000 feet and in the north has the great interior drainage basin in which lies Lake Ngami. The southern part is in the Kalahari Desert.

Dry forests occupy about 52,000 square miles in the northern part of the protectorate. Here are produced mopane and other hardwoods valuable in construction and for cabinet and

other uses. A drier phase, the thorn forest, occupies about 26,000 square miles. The acacia–tall grass savanna covers about 123,000 square miles of good grazing land and is capable of producing crops during good years. A drier type suitable only for grazing is the acacia–desert grass savanna, covering about 70,000 square miles in the southwest. Salt desert shrub of about 3,000 square miles and marshgrass of 1,000 square miles complete the area.

Land Use.—About 78,000 square miles, 28 per cent of the area, is woodland.

FIGURE 188.—Strong corrals are used to hold and protect cattle in many parts of Africa. Mochudi, Bechuanaland.

These dry forests produce a great variety of trees, many of which produce small timber, cabinet wood, nuts, and fruits.

Grazing land of high carrying capacity covers about 176,000 square miles, nearly two-thirds of the total area. Grazing lands of low carrying capacity cover about 99,000 square miles, 36 per cent of the total area. Together they equal the total area of the protectorate. Here are produced cattle, sheep, goats, donkeys, horses, and mules by Europeans, and by natives, cattle, goats, sheep, donkeys, horses, and mules. The total production amounts to 582,000 animal units, or 2.1 animal units per square mile of grazing land. Even for this semi-desert area this production is low. However, the question of water for livestock is a serious one and may prevent the ultimate full utilization of the grazing potentialities of much of this region. Much of the area supports an abundant and varied big game population.

About 175,000 square miles, 64 per cent of the area, is suitable for crop production except during drought years. This uncertainty favored stock raising rather than crop production. Both warm-weather crops such as maize, sorghum, tobacco, and cotton, and cool-weather crops such as wheat and barley may be produced here. The principal crops are tobacco, cotton, and citrus fruits by Europeans, and Kaffir corn, maize, beans, pumpkins, and melons by natives. About 100,000 square miles, a third of the total area, are totally unsuited to crop production and suitable to grazing only (Figure 188).

The agricultural exports are chiefly cattle, hides, butter fat, cream, and skins. They amount to about $7.70 per square mile of agricultural land. The population density is about 0.6 per square mile, or if based on agricultural land, 0.9 per square mile. There are about 87 natives to one European.

The facts that severe droughts occur and that as a whole drinking water is difficult to procure are important considerations and probably account for the low population of both people and domestic livestock.

UNION OF SOUTH AFRICA

The Union of South Africa is made up of the Cape of Good Hope, Natal, Orange Free State, and the Transvaal (Figure 189). To treat adequately each

of these would take more space than can here be given to the whole continent. The total area is about 472,000 square miles and occupies the southern part of the continent. It lies between 22 and 35 degrees south, or at about the same distance from the equator as does Egypt or Florida. It ranges from sea level to 10,880 feet and about 40 per cent of the land area is above 4,000 feet. Most of the area is a plateau bounded on the east by the Drakensberg range. Among the prominent features of the plateau are the high veldt of Transvaal and Orange Free State, the Kalahari Desert, the Karroid Plateau, the great Karoo, the Cape region, and the east coast country.

The vegetation varies with topography and climate and many types are found. In a country as old as the Union of South Africa and intensely developed agriculturally, the vegetation types here considered are the original, not the present cover.

Forests somewhat similar to the high mountain forests of central Africa extend down along the east slope of the Drakensberg range and in sheltered areas reach sea level in Cape Province and in Natal. The principal forests in Cape Province are the Knysna which extend down to sea level. The yellowwoods which form an important part of the temperate rain forests of central Africa are important in these forests. Rough estimates indicate about 5,000 square miles of temperate rain forest, valuable for timber and where cultivation is possible for the production of cool-weather crops.

Temperate brush, a sclerophyll vegetation similar to the chaparral of California and the Mediterranean vegetation, covers about 34,000 square miles, 7 per cent of the total area. This type throughout the world indicates a subtropical climate where cool-weather

FIGURE 189.—The Union of South Africa has an area of nearly 472,000 square miles. About 115,000 square miles are suitable for cool-weather crops, 142,000 square miles for warm-weather crops, and 215,000 square miles for grazing only.

grains, vegetables, and fruits can be grown, and where semi-tropical, citrus, vines, and vegetables of many kinds can also be produced. Many botanists regard it as essentially forest land where fire continually reduces the plant cover to a brush stage. It is not especially good as grazing land but has been so used wherever it developed.

The acacia–tall grass savanna is most extensive and includes what is known as the low veldt, occupying about 142,000 square miles, 30 per cent of the total area. Here are grazing lands of high carrying capacity and suitable to the production of maize, sorghum, and cotton. The tall grass or high veldt is more temperate and better adapted to cool-weather crops. It covers most of the Transvaal and Orange Free State and amounts for all of South Africa to about 76,000 square miles, 16 per cent of the total area. This is crop land and grazing land of high carrying capacity suitable for cool-weather crops and for maize and fruits. Acacia–desert grass savanna too dry for crop production but grazing land

FIGURE 190.—Mango is an important plant in Tanganyika and Zanzibar. It is also grown in the warmer parts of the Union of South Africa. These saber mango trees are sixteen years old. Nelspruit, Transvaal.

of low carrying capacity, covers about 39,000 square miles, 8 per cent of the total area. Very similar to this but less valuable for grazing are the thorn forests which are scattered through the semi-desert country and probably cover about 8,000 square miles. An unusually luxuriant phase of this type is found in the Addo Bush. Desert shrub, often valuable grazing land because of the karoo bush and other edible species, covers a large area of about 120,000 square miles, one-fourth of the total area, mostly on the Karroid Plateau and adjacent regions. True desert of about 2,000 square miles completes the area and is found on the northwest coast.

Land Use.—The forests occupy or once occupied about 5,000 square miles, much of which has been replaced. Timber is derived from the yellowwoods and others of the larger trees, and a great amount of wood and small construction wood is used for cabinet work. Woodlands are rather extensive and probably occupy about 42,000 square miles, 9 per cent of the area. Probably these are more valuable than the forests for they produce a great variety of woods and small timber, for farm and industrial use, cabinet and wagon wood, and fuel. These are chiefly African olive, stinkwood, assegai, white pear, Clanwilliam cedar, waterwood, and mopane.

Grazing land of high carrying capacity covered about 218,000 square miles, 46 per cent of the total area. An even greater area of 247,000 square miles, 52 per cent of the area, is grazing land of low carrying capacity. These combine to give a total of 465,000 square miles, nearly 98 per cent of the total area, as grazing land, about half of which is high carrying capacity land. Here are produced cattle, sheep, goats, horses, donkeys, pigs, mules, and ostriches. All except the ostriches are produced by European and native husbandmen. Only the Europeans produce ostriches.

The total production measured in animal units is 23,337,000, or 50 animal units per square mile of grazing land.

Land Classification.—Cool-weather crop land occupies about 115,000 square miles, nearly a fourth of the total area. This is largely in the Cape region and on the plateau in the Transvaal and Orange Free State. Here the principal crops are maize, wheat, oats, teff, lucerne, rye, barley, peas, beans, potatoes, and deciduous fruits and vines.

Warm-weather crop land occupies a somewhat larger area, or about 142,000 square miles, 30 per cent of the total area. Here cool-weather crops can be grown as winter crops and also strictly warm-weather crops such as pineapples and cotton. The principal areas are in the east and north. Here the principal crops are maize, sugar cane, cotton, citrus, tobacco, bananas, pineapples, and other semi-tropical fruits (Figure 190) and vegetables.

About 215,000 square miles, 46 per cent of the total area, is too dry for crop production and is suitable for grazing only. Here are values in forage,

especially valuable when supported by irrigated land to produce additional or concentrated foods.

The principal agricultural exports are wool, maize, hides, skins, wattle, mohair, maize meal, tobacco, wines, and ostrich plumes, amounting to about $551.00 per square mile of agricultural land.

The population density is 15 per square mile, or, if only land capable of agricultural production is considered, 28 per square mile. There are about 3.2 natives to one European.

BROOMCORN INDUSTRY OF COLES COUNTY, ILLINOIS

Louise M. Trager

FROM the time Coles County, Illinois, was settled (1857) it has been prominent in the production of broomcorn. This county is located in the heart of one of the three major broomcorn areas of the United States, known as the Central District (Figure 1). The other two major areas are the Lindsay District, in south-central Oklahoma, and the Western or Dwarf District, which extends in an irregular curved fashion around the Panhandle of Texas. There is a fourth and relatively small area in and around Bee County in southern Texas (Figure 2).

Broomcorn Culture a Localized Industry

Thus it is apparent that broomcorn production is centered in a few restricted localities. If soil and climate were the only factors limiting its production, it might be grown in all but a few states. A fair crop of broomcorn can be produced where summer temperatures are high enough and soil suitable for corn grown for grain to do well. However, broomcorn differs from corn in its ability to make better use of a limited supply of water and in being more sensitive to the influence of cold nights.

Limited demand for the crop prevents it from being grown on a wide scale. Broomcorn is grown for one purpose in America, the making of brooms and whisk brooms. The part of the plant used is a brush growing from the top of the stalk (Figure 3). Annual consumption of brush in the United States is about 45,000 tons. Production for 1940 is estimated at 41,400 tons. There are approximately 10,000 farmers in the United States who, from year to year, include broomcorn in the farm program. Comparatively little broomcorn is exported. Consumption of broomcorn brush, therefore, has almost a fixed limit.

Distribution of broomcorn is characterized by relatively small areas of high density. Two factors prevent the industry from spreading. Broomcorn is marketed to better advantage in a community where much of it is grown. Since it is seldom that there are ever two crops alike in quality, there are no market quotations as for other crops. The crop is sold by growers directly to local dealers. These dealers have as their customers certain manufacturers. Every dealer knows from past experience with his customers what kinds of brush each desires. Formerly the manufacturer or his representative visited the broomcorn areas and bought directly from the farmers. A buyer sought areas where there was an abundance of broomcorn to suit his particular needs. Today a dealer finds it inconvenient to go as far as ten miles to see a crop of broomcorn. In that case the farmer has to bring the sample to him and under such circumstances the price received is not so satisfactory as when the dealer sees the entire crop.

Another keenly felt need for growing broomcorn in neighborhoods is brought about by the method of harvest and preparation for market. The character of the crop demands that it be cut in a

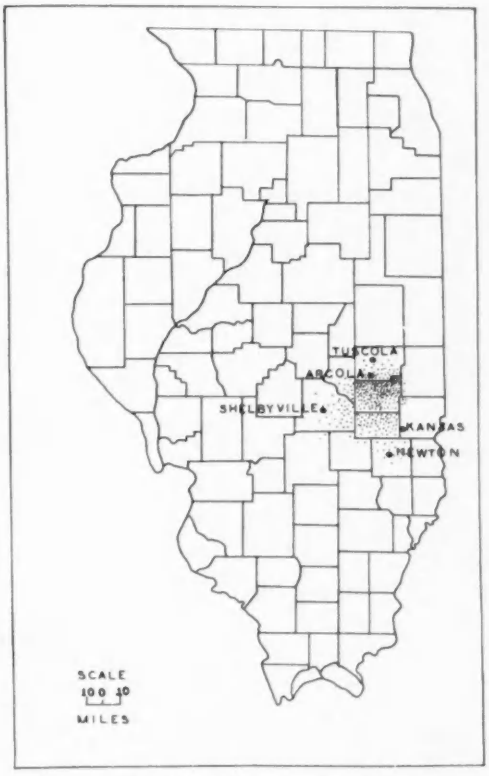

FIGURE 1.—Distribution of broomcorn in the Central District. Coles County is the county south of Arcola. Each dot represents 150 acres of broomcorn. Figures are for 1934. (Source: Illinois Department of Agriculture, Springfield, Illinois.)

certain stage of its maturity and that it be done in as short a time as possible. To accomplish the harvest in a successful manner thirty-five men are needed for two days to cut and thresh the brush from twenty acres. Managers of these crews prefer to go into neighborhoods where there is much to be cut.

CROP SPECIALIZATION IN EACH DISTRICT

In none of these districts is broomcorn the major crop. In the Western District the chief dependable grain and feed crops are the sorghums, Kaffir corn, milo maize, and federita. In the Lindsay District cotton and corn are the competing cash crops. In the Central District the major cash crop is corn. In 1935 broomcorn occupied 33,355 acres in Coles County or over 15 per cent of the area of cropped land. Maize acreage totaled 40 per cent of the cropped land area and soybeans occupied 16 per cent. (This high acreage was partly due to the fact that in 1934 a severe drought curtailed broomcorn production in the two western districts. Figures are from the office of Coles County Agricultural Conservation Association. That year there was on file a record of land use for every farm in the county, an accurate compilation of data.) In 1940 about 25 per cent of the cropped land of the county was in soybeans. Soybeans can be used in the farm program for conserving acres if plowed under green or cut for hay.

Broomcorn is usually not made the principal crop in the farm program partly because of its speculative character. Nevertheless, most of those who raise it continue its production year after year and thereby gain. Illinois is commonly in a position to profit if the price is high, for as far as weather is concerned, the crop stands to be a success seven or eight years out of ten. It should be understood, however, that demand as expressed in price varies and thus culture of the crop involves more than one speculative element.

Permanence of broomcorn in the crop combination of those who raise it is necessary at the start. Broomcorn is an expensive crop to produce because of the large amount of labor required for harvest in the short time this work must be done, and the special equipment required to handle the crop properly. Equipment necessary to harvest and prepare the crop for market consists of seeder, baler, dump rack, and curing shed. A seeder and baler can be hired but only if the grower pursues the raising of broomcorn over a period of years can

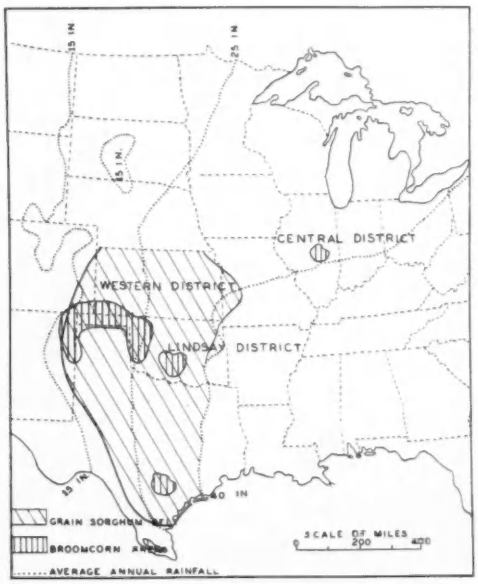

FIGURE 2.—Major areas of broomcorn production and the grain sorghum belt. (Sources: Year Book of Agriculture, 1936, and Fifteenth Census of the United States, 1930.)

he afford to build a shed. (The name "seeder" has been given to the machine for threshing broomcorn.)

A further reason why a broomcorn grower to be successful should continue production of broomcorn is to gain skill in handling the crop. A poor crop is often due to lack of care in harvesting the brush and preparing it for market. The baled brush of the Central and Lindsay districts brings a better price than that of the Western District partly because of the more intensive methods used in its culture in these districts. The first broomcorn grower in the Lindsay District came from Illinois and knew the proper cultural practices.

Obviously this industry is not a large one which might be considered the basis of prosperity of a large region but rather a relatively small activity which is significant because of its extreme localization and because of the widespread distribution of its market. Further investigation shows that this industry is interesting because of the unusual character of the plant and peculiar methods of harvest.

BROOMCORN PLANT

The presence of broomcorn in the southern part of the Great Plains suggests that it is a drought-resisting, heat-enduring plant. A knowledge of the characteristics of the plant will aid in an understanding of its distribution.

Broomcorn belongs to the sorghum species of the grass family. The sorghums in general are separated into the following four agricultural classes: the grass sorghums, the sorghos or sweet sorghums, the grain sorghums, and broomcorn. Broomcorn differs from the other sorghums in having the seed borne on long straight branches. The fibers of the brush are flexible and taper to a fine point. These latter qualities make broomcorn brush superior to other fibres for sweeping.

The kind of broomcorn raised in each district depends upon reaction of the plant to elements in environment. Since there are two groups which differ widely in their characteristics, and react differently to environmental conditions, it is necessary to know the chief characters by which these two groups differ from each other in order to understand their distribution.

These two distinct groups are the standard and the dwarf. The standard is grown chiefly in the Central and Lindsay districts. The dwarf is produced in the Western District and in Bee County in southern Texas. The Central District produces the dwarf for seed.

First, standard and dwarf are distinguished by the height of the plant. The standard is tall and the dwarf is short. The standard sometimes reaches a height of fifteen feet (Figure 3) under the humid conditions of Illinois, where

the average annual rainfall is about thirty-eight inches. In the Lindsay District, where the average annual rainfall is but twenty-three inches, it grows to a height of only eight to ten feet.

The height of the dwarf varies with environmental conditions as does the standard but is usually from three to six feet. Less water is required for its support than for the standard, therefore it fits into the Western District, where the average annual rainfall ranges from twenty-five inches in the eastern part to fifteen inches in Baca County of southeastern Colorado (Figure 2). The shorter stalk of the dwarf is not bent and broken so readily by the high winds of the Great Plains as is the standard.

Another characteristic places the dwarf in the Western District and the standard in the more humid areas. The two groups are distinguished by the tenacity and manner of attachment of the brush. The standard has the stem of the brush firmly attached to the stalk and well extended from the boot or leaf sheath that encircles the stem of the brush. This latter condition prevents water and plant lice from accumulating in the boot. Water in the boot or injury to the plant from insects will cause a reddening of the brush, an undesirable characteristic from a market standpoint. For this reason, the tall or standard type, can be profitably grown under the degree of humidity prevailing in Illinois. The firm attachment of the brush, in the standard type, requires a more difficult and more costly method of harvest than that required for dwarf.

FIGURE 3.—A field of broomcorn in the northern part of Coles County. The standing stalks in the background show that some method is necessary for bringing the heads down within easy reach for cutting. Harvesters bend the stalks diagonally at a point about three or four feet from the ground. This process is known as tabling. The table serves to keep the brush clean and dry besides providing a place for it to be conveniently reached when the broomcorn is gathered later in the day.

The brush of the dwarf is weakly attached to the stalk and partially enclosed in the boot. Since the latter condition makes possible accumulation of water and plant lice in the boot, the dwarf is more susceptible to red stain than the standard. It is thus adapted only to semi-arid conditions. Under the humid conditions of Illinois it becomes infested with plant lice. The weak attachment of stem to stalk allows an easier method of harvest than that required for standard. Frequently, in the Western District harvesting is performed by members of the family.

Farmers there are less able financially to hire large crews of harvesters than are farmers of the Lindsay District or Central District.

Standard and dwarf types also differ in uniformity of heading. Standard matures more evenly than dwarf. By this is meant the heads are nearer the same stage of maturity at harvest time. Uniformity in quality of brush increases its market value. Broomcorn growers make every effort to produce a crop of uniform quality.

PRESENCE OF BROOMCORN IN COLES COUNTY

The presence of broomcorn in Coles County is associated with the early settlement of the county. Broomcorn spread to the Middle West with the migration of the American settler.

Investigation shows that its cultivation in America began as a garden crop. The first production of broomcorn is credited to Benjamin Franklin. The following quotation relates its introduction into this country.

"Doctor Franklin chanced to see an imported corn whisk in the possession of a lady, and whilst examining it as a novelty, he espied a grain of it still attached to the stalk. This he took and planted, and so we at length have got it in abundance among us." (Washburn and Martin: An Economic Study of Broomcorn Production, *United States Department of Agriculture, Technical Bulletin No. 347*, p. 2, quoting J. F. Watson: Annals of Philadelphia and Pennsylvania, 1859, Vol. II, p. 4.)

The above incident occurred a few years before the Revolutionary War. Following the planting of this one seed, two or three years were required before there was enough seed to be given out that the plant might be grown and become useful. It was some time, however, before production began on a large scale. The first commercial production of the crop began in the Connecticut Valley at Hadley, Massachusetts. in 1797.

Shortly after broomcorn had become established in Massachusetts, production began to shift westward. Soon it became an important crop in the Mohawk Valley in New York. By 1846 it had assumed considerable importance in the Scioto Valley of Ohio. Later its culture spread to Tennessee, Kentucky, and Indiana, thus moving into unsettled areas of cheap land. Brooms were regarded as essential and thus the raising of broomcorn accompanied the migration of the settlers into the Middle West. They took not only food crops, but here another crop considered a necessity. Also, in the early period of broomcorn production the seed was used as feed for livestock. In that case the seed was allowed to ripen and brush was not cut green as it is today. Production of broomcorn was successful in the Middle West, no doubt because of the higher temperatures there which are favorable for production of high quality brush.

About 1830 is the date of the beginning of settlement in Coles County. The early settlers were from Virginia, Kentucky, Ohio, and Indiana. They had brought with them the broomcorn seed and planted it in their gardens many years before the crop was grown on a commercial basis. At that time it was raised only for home use. In 1858 the crop appeared on a commercial basis in Coles County. Twenty acres were planted which yielded between nine and ten tons of high quality brush (this yield is nearly a ton to two acres) for which the grower received $400.00 per ton. Naturally such a return attracted the attention of other farmers. The average yield at the present time is a ton to three acres in the northern

part of the county. In the southern part of the county the yield is a ton to four or five acres. This difference in yield is due to the fact that the Shelbyville moraine, of the last advance of the ice, extends through the central part of the county. North of this moraine, land is richer in plant food and returns higher yields than land in the southern part of the county. The Illinois Central Railroad, which had recently been built (1858), through the western part of the county, also began to interest the farmers in the growing of broomcorn to get additional freight. The county's high rank in broomcorn production has continued to the present time.

For thirty years following the 'sixties Illinois grew the bulk of the broomcorn used in the United States. As the price of land in Illinois advanced, the crop moved still farther westward until the present centers of production were established (Figure 4). An important cause contributing to the temporary decline of broomcorn production in Illinois was the fact that wives of broomcorn growers refused to board the harvesters. To board thirty men for a week or more was no small task. Though rain interrupted the harvest, the labor crew remained with the employer until the broomcorn ready at that time was harvested. Partly as a result of this condition Illinois in 1919, 1920, and 1921 produced only ten per cent of the crop of the United States. Since that time harvesters carry their lunch. Hard roads and automobiles make it possible for them to provide their own lodging.

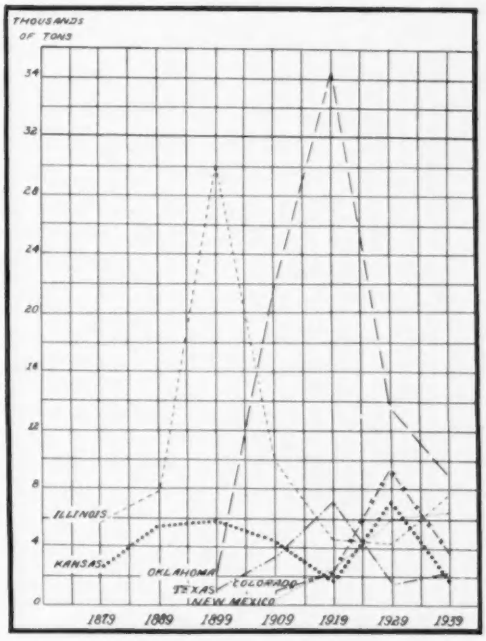

FIGURE 4.—Broomcorn production in principal states decennially, 1879 to 1939. Production figures are in short tons. (Source: United States Department of Agriculture.)

PRODUCTION

An analysis of production of broomcorn reveals an industry which is unique in certain respects. Previous to harvest the practices of production differ but slightly from those of producing corn. On the other hand, methods of harvesting and curing broomcorn are peculiar to the crop. Broomcorn is one crop of the Illinois prairies that has resisted inroads of machines in respect to harvesting and curing. Methods of today do not differ from those of 1870. Brush is cut and prepared for market by hand labor as the quality is improved and consequently the price is increased if the brush is carefully handled. However, climatic conditions have more to do with high quality brush than does the farmer. Particularly during the period of heading and while the crop is being harvested is the weather of great concern.

Broomcorn, being a sorghum, can withstand droughts much better than any other crop grown in Coles County. In Illinois it is injured more often by wet weather than by droughts. The

droughts of east-central Illinois are seldom of such severity as seriously to injure the crop, for during a period of dry weather the plants send down long roots to reach the moisture in the subsoil. Thus not only is moisture brought to the plant but a rich store of plant food is tapped that is not reached in seasons having heavy rain during the spring and early summer. A further benefit of a dry season is that the long roots make the plant more sturdy and thus it is not blown down so easily as when the plant has shallow roots. The standard broomcorn of Illinois is easily blown over because of its tall growth (Figure 3) and the weight of the brush at the top. Broomcorn, however, has the ability to straighten up soon after a windstorm unless the plant has been weakened by chinch bugs. However, a drought too severe while the heads of broomcorn are developing will result in production of spike heads particularly if the stalks are too thickly spaced. Spikes are immature heads. They also occur in broomcorn that has become crossed with other sorghums, an indication that good seed is necessary.

The most critical period during the growth of broomcorn is the time of heading. Heading, the growing of the head or brush out of the boot, occurs about a month before harvest. At this time broomcorn is sensitive to low temperatures. A sudden drop in temperature, usually a warm day followed by a cool night, will cause a crook in the stem at the knuckle. Crooked brush has a market value of about 40 per cent that of straight brush. It is used as a filler or on the inside of the broom. A continuance of cool weather during or after heading will make the brush curly and short. Farmers refer to it as being "kinky." A drop in temperature of continued duration below 60 degrees is enough to produce this effect. Rarely is much of the Illinois crop injured in this manner.

Of greater consequence is rain at the time the brush is coming out of the boot. Effect of rain at this time is reddening of the brush. The quality is actually not affected by this red stain but manufacturers state that it cannot be removed by bleaching or dyeing and thus its commercial value is lowered, for the American housewife demands a green broom. (A few colored brooms are now on the market presumably to fit in the color scheme of modern kitchens. This experiment has been tried before but manufacturers found that sales were slow.) Another harmful effect of rain during the period of heading is the forming of crooked brush. Excessive moisture in warm weather will cause the brush to grow so rapidly that it will bend over from its own weight before it has stiffened. The weight of the brush is further increased by water that hangs to the brush in heavy drops. The normal growth of brush is two inches a day. Frequently the heavy rains are accompanied by strong winds that tangle the brush, thus burdening the task of harvest.

The harvesting of broomcorn is attended with great anxiety on the part of the grower. Major practices in one day's work include tabling (Figure 3), cutting, hauling, and threshing. The performance is one of hand labor; threshing is done by power machinery but hands feed the machines. The major consideration in harvesting the crop is to harvest it so that it will have the best possible appearance, for appearance greatly influences price, particularly if there is an abundance of broomcorn. Brush should be a pea-green color from tip to knuckle. This color occurs when the seeds are in the milk stage.

The prompt cutting and threshing of the brush in a short time requires large

crews of men. As many as forty men may be at work in a twenty-acre field at the beginning of the harvest season. The local labor supply is not sufficient to perform the broomcorn harvesting in Coles and adjoining counties. About 50 per cent of the harvesters come from outside the vicinity. These transient laborers come largely from southern Illinois, Tennessee, and Kentucky. They may engage rooms in the towns or camp out. Those camping often occupy the rural school yards. Some have tents, others sleep under the open sky. Meals are cooked on a kerosene stove. Local laborers, who live within a radius of fifteen miles, drive home each evening.

Cutting does not continue later than about four o'clock in the afternoon in order that the cut brush may be threshed and placed in the curing shed the same day (Figure 5). Exposure to rain or dew after the heads are cut causes the brush to lose its fresh green color and to take on a yellowish bleached appearance. Also, the men who cut must help thresh before receiving their wages, as threshing is an unpleasant task, and it is difficult to secure labor just for that performance. Threshing is unpleasant due to a fine "hair" on the chaff of the seed that irritates the eyes and skin. This "hair" is separated from the chaff in threshing. Many men refuse to work with broomcorn because of the discomforts of "broomcorn itch." After the brush is in the curing shed the farmer's greatest anxiety is over although weather conditions while the crop is curing are of considerable importance.

Brush is laid on slats in the curing shed (Figure 5) from two to four inches deep depending upon the weather conditions at the time and the condition of the brush. If the layers are too deep, the brush will heat and "sweat," giving it a bleached appearance which is referred to as "shelf burnt." Rapid drying without direct sunlight is necessary for the brush to retain its uniform green color. Brush loses about one-half its weight during curing by evaporation of the water it contains. Dry weather, low relative humidity, and winds are necessary to accomplish this result. At Charleston, Illinois, for the eleven-year period from 1925 to 1935 September had a heavier average rainfall than any month except May. This seems to indicate an unfavorable condition for harvesting and curing broomcorn. Figure 6, however, shows that for the same period there is an average of 21.2 days without rain for September. The number of rainless days in August and September (Table I) indicates that the

FIGURE 5.—Shed filled with brush in the process of curing. The shed is open to permit free circulation of air.

TABLE I

DAYS WITHOUT RAIN—CHARLESTON, ILLINOIS

Year	*August No. of Days Without Rain*	*September No. of Days Without Rain*
1925	23	23
1926	23	11
1927	22	23
1928	26	22
1929	26	21
1930	26	22
1931	19	24
1932	23	24
1933	25	24
1934	17	17
1935	24	23
Average	22.9	21.3

distribution is in heavy showers. Clear, sunny, warm days intervening is the weather characteristic of the Central District. The average mean temperature at Charleston, Illinois, for August and September for the period 1925 to 1935 is 76.5 degrees and 70.5 degrees respectively. The length of time required for brush to dry properly ranges from two to three weeks. If a second field is ready to be cut before the crop in the shed is ready to be baled, the brush is taken from the shelves and bulked down.

Bulking consists of stacking the brush on the ground in the driveway of the shed in piles four to five feet high. Two rails are placed every two feet to separate the brush. The advantage of bulking the brush before it is baled is that it provides shed room for the next cutting and also makes a more compact bale. Little bulking is done these days except for shed room. Formerly, when nearly every farmer kept a steady hired man, broomcorn was bulked, as it provided labor for the hired man and condensed the labor of baling. Fewer men are needed to carry the brush from the bulk pile to the baler than from the shelves to the baler. Few farmers now keep a steady hired man unless farming over 200 acres. The tractor has taken the place of the steady hired man.

MARKETING

The marketing of broomcorn differs from that of the chief agricultural commodities in this country. Broomcorn is a cash commodity with no future dealings as in the case of grain. There is no established market as for other farm crops, since it is seldom there are ever two broomcorn crops exactly alike. Thus there can be no market quotations on broomcorn for the brush cannot be graded satisfactorily. There is no state inspection of broomcorn as for grain. Also, broomcorn prices are not controlled by world conditions of supply and demand but by domestic supply and demand. The price to the farmer is determined by an agreement between him and the local dealer and depends chiefly upon the quality and length of the product and the size of the entire crop of the country.

As previously stated, marketing of broomcorn is performed in the simple manner of buyer meeting seller. Local dealers purchase the broomcorn on orders of the manufacturers. Only about 15 per cent of the Illinois crop is bought by dealers on speculation. The dealer receives a commission of ten dollars per ton for arranging the purchase and pays the cost of weighing and loading. The manufacturer pays the cost of transportation. About half of the Illinois crop is sold directly to broom manufacturers or their representatives who visit the district to see the crop before it is bought. The remainder of the crop is bought by the manufacturer upon recommendation of the dealer. There is a close relationship between dealer and manufacturer. Manufacturers send samples of their product to dealers to keep them informed as to the type of brush desired. Also, dealers visit the plants of manufacturers to learn what types of brush each uses. The nature of marketing is such that it is necessary for broom manufacturers to place greater confidence in their dealers than is necessary in most other lines of business.

This method of marketing is necessary because no system of grading has been adopted. Grading is complicated because broomcorn does not grow uniformly. Variations in quality of brush depend upon the following factors: quality of seed, fertility of soil, planting date, thickness of stand, uniformity of

sprouting, temperatures and amount of rainfall during growing season and particularly at time of heading, stage of maturity at which the crop is harvested, weather conditions at time of harvest, care exercised in shelving, and weather conditions while crop is curing. Therefore, broomcorn would have to be described very much in detail if buyers did not visit the areas where it is grown to select what they want or if they did not buy upon recommendation of the dealers who know what they want. This method of marketing is costly but such is the result of the nature of the crop.

Furthermore, grading is unsatisfactory because demands for brush vary according to types of brooms made. What would be considered highest type by one manufacturer would be of less value to another. Brush may be classified either according to its suitability for different types of brooms made or with respect to the part of the broom for which it is to be used. The kinds of brooms recognized by the trade are household and industrial. Household are the lighter weight type used generally by the housewife. This type constitutes about 80 per cent of the brooms manufactured. They are referred to as parlor brooms. In this class are several grades of brooms depending upon the quality of the brush used. A number one grade of parlor broom is made entirely of fine fibered brush. A poorer grade has coarse brush on the inside with a fine fiber covering. An inferior grade is made of coarse brush with some other fiber than broomcorn on the inside. Industrial brooms, often referred to as warehouse brooms, are used for heavy work. They are used in warehouses, by railroad companies to sweep out switch frogs, and for similar heavy work. They are made of coarse brush. Imported split bamboo is used on the inside to give stiffness and firmness and better wearing quality. Also, soap-weed from the semi-arid territory of the West is split and used as a filler in industrial brooms. Many of the industrial brooms are made of fiber other than broomcorn, hence the demand for heavy broomcorn brush is slight.

With respect to the part of the broom for which it is to be used, brush is classified as follows: (1) insides; (2) covers; (3) hurl, and (4) self working. It is chosen for the parts of the broom according to its length and quality. Insides consists of short brush, fifteen inches or less, which need not be of fine fiber except in high-grade household, as it is used on the inside of the broom being placed directly on the handle. Covers is the term applied to brush slightly longer, fifteen to eighteen inches, which is used to cover the insides. Hurl is fiber, eighteen to twenty-six inches, and is used on the outside of the broom. Self working is the term applied to broomcorn that can be used to make a whole broom. In other words it contains various lengths and qualities of fiber. Illinois broomcorn is generally self working.

Among other things, length of brush desired depends upon the part of the country where the broom is made. Eastern brooms are not so long as those of the South, West, or Middle West. The East makes brooms mostly for household use and a short broom of fine fiber is desired. In fact, but little long brush is sent to factories east of Pittsburgh. New England factories use a short brush also because of the character of the manufacturer. A Yankee will not cut off any of the brush to make it the desired length. Furthermore, a broom has lost the part which makes it valuable for sweeping if the tips have been cut off. The South uses long brush. Canada buys a brush of

medium length. Institutions for the blind and prisons buy the long fiber.

Quality is determined largely by color, fineness of fiber, and growth. Fibers of high quality broomcorn are fine, straight, have smooth growth their entire length, are of pale to pea-green color, free from stain or discoloration, and are of uniform length in the completed broom. All brush is dyed to a certain extent. The best brooms are made of brush dyed very lightly. Cheap brooms are often dyed heavily to cover stain and blemishes. During and since the depression, manufacturers have made mostly the cheap brooms, hence most of the demand at present is for medium and common grade brush. This condition has caused the industry to flourish in the Western District where a grade of brush is grown that is lower in quality than that of the Lindsay or Central districts. Use of substitutes is limited when the price of broomcorn is $125.00 per ton or less.

Growth of brush may be such that it has thin tip or full tip. The use of full tipped brush eliminates waste; the short fibers in a head of thin tipped brush must be cut off. If long enough, they may be used in the manufacture of toy brooms and whisk brooms, otherwise they are wasted. Heads with thick center stems are used only on the inside of cheap brooms. They are used to stiffen the broom and are used also because brush of this growth is cheap. High grade household brooms are never made of brush with prominent center stems as brooms of this type should be pliable. Spike heads are sometimes used in cheap brooms but this is a bad practice among broom manufacturers as these spikes fall out and cause the housewife to use a carpet sweeper or dust mop instead of a broom. The Central District produces a small amount of brush of defective growth as compared with the amount produced by the competing districts.

Size of the broomcorn crop of the country and amount and kind of carryover from the previous year have had a greater influence on the price of broomcorn than any other factor. Variability of rainfall from year to year in the broomcorn areas results in fluctuation in annual production and thus in fluctuation in price. Following a year of high prices there is heavy planting and, if weather conditions are favorable, an oversupply is created with consequent drop in price. Large dealers and manufacturers study conditions closely by sending representatives over the producing areas from time to time to estimate number of acres planted, number of tons harvested, and length and quality of brush. The use of imported broomcorn is invited following a season when production is light. In 1930 a tariff of twenty dollars per ton was placed on foreign broomcorn and a tariff of ten dollars per ton on Japanese rice straw. In spite of the tariff, foreign broomcorn entered in considerable amounts following the dry season of 1934. Only a few countries produce broomcorn in excess of domestic demands; they are: United States, Argentina, Hungary, and Italy. Ocean freight rates compare favorably with rail rates. However, an added expense to imported broomcorn besides tariff is a fumigation fee of ten dollars per ton. Fumigation is required by law because of the fact that the European corn borer was brought into this country in a shipload of broomcorn. The only fumigation ports and hence ports of entry are Boston and New York.

The Illinois broomcorn district has the advantage of being nearer the principal marketing area than the Lindsay or Western District. The bulk of the Coles County crop is marketed east of

the Mississippi River and north of the Ohio. Here are manufactured about 60 per cent of the brooms of the country. This location of broom manufacturing is accounted for by the fact that it is cheaper to ship the baled raw product long distances in carload lots than to ship the finished brooms in small quantities. The freight rate on brooms is three times that for broomcorn. Broom manufacturing began in the East not only because of nearness to centers of population, but also because of nearness to centers of production. In 1933 there were 1,418 broom establishments west of the Mississippi and 1,375 east of it. (F. F. Collins, Arcola, Illinois, secretary of National Broom Manufacturers' Association.) But the number of broom plants in a limited area is no indication of the output of brooms. The eight factories of Amsterdam, New York, turned out more brooms than the fifty-one broom plants of New York City. Of the total number of broom establishments only about 400 can be called factories. The others consist mostly of one-man establishments that are often temporary. These small factories have sprung up in or near the areas of production to supply local demands for brooms. The total number includes also penitentiaries and working homes for the blind where brooms are made. Five to ten per cent of the brooms are made by the blind.

The dominant factor determining which method of transportation is used in moving broomcorn is distance. Most of that which goes within a radius of 500 miles is carried by truck. Beyond this distance it is shipped by rail. Consequently 50 per cent of the crop moves by truck though the radius of the territory served by truck is constantly widening.

The displacement of the railroad by motor truck has been an advantage to the manufacturer. A truck carries a smaller quantity than a railroad car. The average truck hauls forty bales which is half a carload. The smaller quantities are preferred by small manufacturers. They buy less than carload shipments and the freight rate in that case is higher than for carload shipments. Moreover, the truck can back up to the door of the factory and thus truck haul from railroad car to factory is eliminated as many manufacturers do not have railroad sidings built up to the factory. Truck transportation is convenient for the manufacturer, also, because he can get the broomcorn when he wants it. Railroads can offer no advantage over the truck at least for short distance shipping for the rates by truck are as cheap as by rail.

As previously stated, Coles County holds a prominent place in the broomcorn industry of the United States. It holds this place because it produces high quality brush more regularly than any other area and because it lies within the principal consuming area, whereas the competing districts lie outside. The importance of these two conditions is emphasized when it is recalled that the nature of the crop has prevented quoted prices and that purchases and sales are made by oral bargaining at convenient shipping points within the county. This means that buyers come from many parts of the United States and Canada. The position of Coles County, near the center of the nation's transportation pattern, favors rather than handicaps this movement of buyers and likewise favors the subsequent shipment of broomcorn to market centers.

EVOLUTION OF THE IRISH RAILWAY SYSTEM

Charles A. Fisher

ANY study of development of rail communication in Ireland must plainly derive from three sources. One is an understanding of the geographic position of this country; a second is a knowledge of the physical features of the island; and the third, a study of its economic history in the nineteenth century.

The question of geographic position introduces at once one problem of Irish development. In some respects Ireland is the outpost of Europe; in others it appears to be linked closely to Great Britain. This is apparent immediately in growth of the communication system. English influence on railway construction and maintenance is plain, and the point will be discussed more fully later. But in the important matter of gauge, for example, Ireland remained distinct from England, Scotland, and Wales, adopting the 5′ 3″ as standard. It is interesting to note at the same time that the only other European countries departing from the 4′ 8½″ gauge are Portugal, Spain, and Russia, all on the periphery of the continent.

The physical features of Ireland favor, on the whole, economical building of railways. Much of the country, especially the Central Lowland, is free from obstacles which necessitate embankments or expensive cutting of tunnels. In the hilly country of the north and south, the character of the ranges is such as to offer almost the minimum interference to rail construction since the highest parts are peripheral. The uplands of Antrim, Donegal, and Kerry are good examples of this natural asset. This distribution made it possible in the nineteenth century to build the earlier main trunk lines over the predominantly low, or at the worst, merely broken country, and to leave the opening up of the mountainous areas until changing economic conditions, and new engineering methods could repay such schemes.

Favorable physical features largely account for the fact that average cost per mile of the Irish railways has been about a quarter of that in Great Britain. It is necessary to remember also, however, that in few cases in Ireland did railway builders encounter the demand for fabulous prices for land, which so often raised initial expenses of railway construction in England.

Only the hills of the Leinster Chain, owing to its nearness to Dublin, the greatest focal point of communications, have formed an awkward obstacle to railway development in Ireland. On account of these difficult relief features in the southeast, builders of the Wexford railway were forced to divert the track to the coast for many miles. The extreme closeness with which the Wexford railway follows the coastline is not only due to the difficult relief features of County Wicklow. The route, which is in many cases miles from the places it was intended to serve, was chosen for two reasons. In the first place, the engineer, I. K. Brunel, was anxious to display his technical skill to the furthest possible extent, and in the second, the Earl of Meath did not want the railway to bisect his estate; accordingly he made a gift of the land round the coast. The Dublin, Wicklow, and Wexford Railway Com-

pany, which later changed its name to the Dublin and South-Eastern Railway Company, has paid dearly for this earlier heedlessness in choosing the details of the rail route. Maintenance expenses due to ravages of marine erosion have been heavy, since parts of the track have had to be relaid farther inland. The problem of upkeep of tunnels and of open sections of the line in the striking quartzite masses which form Bray Head has also been a serious one owing to undermining by the sea. Coastal railways are indeed common in Ireland, owing to the distribution of the main towns, but apart from the Dublin-Wexford line, no serious problems have been associated with their construction. On the contrary, in some cases, like the Dundalk-Greenore-Newry district for example, an almost ready-made rail bed has been provided by the raised beaches. The exception to favorable conditions for coastal routes for railways, apart from the Wicklow region which has already been discussed, is in the west of Ireland. There, the exposed position of some railways has been responsible for recurrent accidents during high gales. Instances of this danger to rail communications are the records of disaster on the narrow gauge lines serving Dingle and Tralee in County Kerry, and Burtonport in Donegal. Elaborate precautions to meet this threat have been introduced on the West Clare Railway; these include installation of anemometers, and provision of specially ballasted rolling stock, which alone is allowed out when the wind reaches sixty miles per hour. All traffic must cease in gales reaching eighty miles per hour.

In contradiction, also, of general expectation bogs of the Central Lowland did not present very serious difficulties to the railway engineer. Numerous esker ridges and other glacial deposits

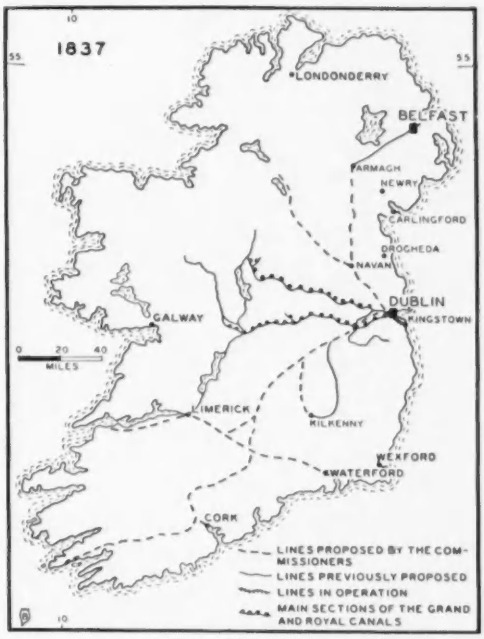

FIGURE 1.—The railway network for Ireland devised by the Drummond Commissioners in 1837. The Limerick and Waterford Company had been incorporated in 1826, but as its proposed work was not carried out, its powers lapsed. In 1837, the construction of a line between the points mentioned was considered by the Drummond Commission.

have provided natural routes across them, and incidentally have furnished the railways with abundant supplies of gravel ballast for their tracks. (The M.G.W.R.—Midland Great Western Railway—serving the greater part of the Central Plain, relied very largely on gravel ballast.) There are, it is true, certain stretches of line which need special attention on account of boggy conditions, but these are not nearly so extensive as might be supposed.

One might mention also as a further potential asset to railway development in Ireland, easy access to supplies of imported coal. Ireland itself is poor in mineral resources, but coal can be shipped cheaply both from Ayrshire and from South Wales for use on the railways. The fact that the highest quality "loco" coal used on English

railways has never been available for Ireland is a man-made rather than a geographical problem.

These geographical conditions have had direct and obvious effect upon evolution of rail communications in Ireland, but the more indirect and complicated influences also need consideration. For centuries before the railway era, road communications in this country had been gradually taking shape, and during the second half of the eighteenth century, Ireland, like England, had experienced an outburst of activity in canal construction. The canal system centered on Dublin, which was the unchallenged focal point of Irish communications until the rise of Belfast, and early road and canal networks are both interesting in their connections with the first phase of railway planning. In general, the main rail tracks tended to follow long established road ways, since these naturally indicated the easiest lines of communication between Dublin and the leading provincial towns. Canal routes, however, were at first avoided by rail builders, since competition between rail and canal was expected to be ruinous to both. The question of rail and canal competition in the early days of the railway era in Ireland received special consideration, since the two main canals, the Royal and the Grand, both cross the Central Lowland from Dublin Bay to the Shannon. This was a comparatively poor area which could not support competitive systems of transport. Neither canal extended west of the Shannon into Galway.

The Act of Union of 1800 is a significant episode in the economic as well as in the political history of Ireland. It marked the beginning of a period when proximity of Ireland to England, and when interdependence of the two countries were at least as noticeable as was the unique position of Ireland as the outpost of Europe.

The remarkable changes in Irish economy, and in consequence in the Irish landscape, which are associated with the Industrial Revolution, were not, however, really apparent until close on the middle of the century. Up to the forties the continued tax on wheat imported into the British Isles brought a certain amount of prosperity to Ireland. This was reflected in an increase of population from 4,500,000 in 1800 to nearly 9,000,000 in 1846.

The disastrous failure of the potato crop in that year, however, and the famine which followed, showed plainly that Irish farming at the existing standard of production could not at the same time achieve a grain export and provide for an increasing population. Moreover, the immediate effect of the repeal of the Corn Laws in the same year was to increase distress. Much land in Ireland reverted quickly from arable to pasture, causing widespread hardship to the rural population.

In consequence the later half of the nineteenth century saw a series of drastic population movements in Ireland, which cannot be ignored in any study of railway development. Between 1847 and 1857 over 1,500,000 people emigrated, and the outflow continued steadily until by 1881 the total population of Ireland had sunk to about 5,000,000. This sharp decline in population formed a strong contrast to the general trend in nineteenth century Europe.

Within Ireland, also, migratory movements were remarkable. The most noticeable of them was a shift of population from west to east which showed the growing economic interdependence of England and Ireland. The inhabitants of Dublin numbered 186,000 in 1822, and 289,000 in 1901. The follow-

ing statistics of fluctuations in the town populations of Ireland are interesting: Three towns in the northeast which derived their vigor from development of Belfast showed substantial increases between 1861 and 1891; Lisburn in Antrim from 7,503 to 12,250; Lurgan in Armagh from 7,772 to 11,429, and Londonderry from 19,973 (1851) to 33,200. The first phase in growth of the northeastern towns was associated with textile industries, and later ones with shipping and metallurgical production. Kilkenny in the south, which was designated by the Drummond Commissioners as an important inland town, declined from 19,975 inhabitants in 1851 to 11,048 in 1891. But the most significant change, and in many respects the exception to the general course of economic development in Ireland, was the phenomenal rise of the northeastern manufacturing region of Belfast. Partly on account of the possibilities of coal import from Ayrshire, and partly because the system of land-ownership and tenure in Ulster encouraged accumulation of capital, this part of the country was able to seize opportunities which had been exploited by regions with similar advantages in England and Scotland. From being a small town of 25,000 inhabitants in 1800, Belfast grew steadily until by 1850, the city had superseded Cork as the second city in the country. In 1851 Belfast had a population of 117,000. Figures given at the 1937 census for Belfast were 438,112. Those for Dublin in 1936 were 467,691.

The growth of Dublin and Belfast was achieved mainly through flight of the population from towns, whether large or small, and from rural areas of western Ireland. The population of Cork declined from 80,720 in 1841 to 75,345 in 1891; that of Limerick over the same period from 48,391 to 37,155, and that of Galway from 17,275 to 13,800. The trend of internal migration in Ireland was not, therefore, the simple one of country to town, which was common to many countries in the nineteenth century; it was also a shift from the Atlantic littoral to the eastern districts which were more closely associated with English and Scottish economic activity.

The recurrence of economic distress resulted in a number of administrative experiments, thought out both in England and in Ireland. The wisdom or unwisdom of the government of Ireland in the nineteenth century is not a matter for discussion in this article, but some of the remedies applied deserve comment, because they have direct bearing on the program of railway construction. The two pieces of social legislation which need mention are the great Land Act of 1885, which provided financial assistance for small tenants to purchase their holdings, and establishment of the Congested Districts Board in 1891, whose members attempted some improvement in the shocking circumstances of the peasants of western Ireland. These palliatives were among the first measures of the policy of "killing Home Rule by kindness." They were in part effective, since the decade before the 1914–1918 war was one of comparative material prosperity in Ireland. One can, indeed, trace in that country a pattern of economic development which is comparable on a reduced scale to that in England and south central Scotland, especially in the redistribution of population. This is reflected in the evolution of the railway system to meet changing needs of the countryside. But in many respects, conditions in Ireland and England were very different. Protection for Irish industries had been abandoned long before repeal of the Corn Laws, and most Irish enterprises,

apart from those in Ulster, were quite unable to withstand the competition of their more firmly-rooted rivals in Great Britain. Ireland was thus prevented from absorbing its growing population into industry; instead the more enterprising of the Irish peasantry were forced to emigrate to Great Britain, mainly to the towns, and to both urban and rural areas in the United States.

The railway network which developed in the nineteenth and early twentieth centuries was certainly a partial reflection of the geographical and economic circumstances which have just been described. It is true that the railway engineers could not ignore the physical features of the country, and that the government in London had to take into account the troubled history of the Irish people, especially in the years following the "Hungry Forties." But at the same time, it is apparent that the railway system of Ireland, primarily a farming country, shows in part a disastrous absence of planning, and in part the preoccupation of British statesmen and technical experts with the elaborate requirements of England, a land of ample capital and rapidly growing industries. Instances of that rather unsuitable connection between English and Irish railway development are numerous. Incorporation of the first Irish line in 1831 took place soon after opening of the Stockton and Darlington Railway in 1825. The first Irish railway between Kingstown and Dublin, opened in 1831, was one of the earliest lines in the United Kingdom. There were only three preceding it in Great Britain: the Stockton and Darlington opened in 1825, the Liverpool and Manchester opened in 1830, and the Dundee and Newtyle opened in 1831. The "railway mania" of the late 'forties extended to Ireland, even though its intensity was lessened on account of the famine; and the demand for acceleration in Great Britain at the end of the nineteenth century was marked in Ireland by the inauguration of the four-hour service from Dublin to Killarney (187 miles) in 1897. Moreover, regulations imposed by the Board of Trade, the severity of which was fully justified in industrial Britain, placed a severe handicap on rural Ireland, where the volume and speed of railway traffic did not warrant the same exacting degree of technical refinement.

The maps accompanying this article provide the clearest method of analyzing growth of the Irish railway network, and the reader will find it best to follow the record of construction by close reference to these illustrations.

Figure 1 shows the earliest design for railway development in Ireland. In that year only one line was in existence, namely, the railway between Dublin and Kingstown. The history of these few miles of track illustrates well the early rivalry between canal and rail communications. Kingstown had been growing as an outport of Dublin since the end of the eighteenth century when choking of the mouth of the Liffey with sandbars began seriously to hamper navigation. In 1826 Kingstown superseded Howth on the outer shore of Howth Head, as the mail packet port. Need for improved communications between the outport and the capital brought forth proposals for a ship canal, but since the estimated expense was prohibitive, there arose the alternative suggestion of a railway. Despite much opposition from the prospective canal builders, the Dublin-Kingstown line was opened on December 17, 1834. The gauge chosen was 4′ 8½″, already in operation in Great Britain.

The lines shown on Figure 1 are those

for which Parliamentary sanction had been obtained by 1837, and those which were recommended for construction by the Drummond Commission. This body was established in 1836 to study and to report upon the most suitable means of introducing rail transport into Ireland. Although recommendations of the Commissioners were not closely followed, their suggestions are interesting enough. The very creation of such a commission implied recognition in London that the requirements of Ireland in railway development were likely to be different from those of Great Britain. Indeed, the view was widely held that, in anticipation of the small volume of traffic, the Irish railway system should be limited to a few trunk lines to be built by the state. It was perhaps unfortunate for the future of Irish railway communication that the opinions held at the time of the Drummond Commission Inquiry should have been superseded by those in favor of a free rein for private enterprise. The only concession made to the peculiar circumstances in Ireland was authorization granted to the Commissioners for Public Works to make loans, as occasion demanded, to assist railway building.

A second point of interest in the Drummond schemes is the clear indication of the importance of Dublin in the life of Ireland during the early nineteenth century. The railway system devised by the Commissioners was to consist of two main trunk lines: one was to run from Dublin to Cork, and the other from Dublin to Belfast. There was a wise recommendation that these lines should be built by two separate companies, owing to the wide differences in operating conditions between south and north. The two main lines projected and the subsidiary tracks followed existing roads already served by mail coaches, but the Central Lowland was avoided in the Commissioners' plans on account of the canal facilities already established. Although the Dublin and Drogheda Railway had received its Act of Incorporation in August 1836, the Commissioners proposed to link Dublin to Belfast by a new line through Navan joining the Ulster railway at Armagh, since the Carlingford Mountains were held to be too great a barrier to a coastal route. A third notable feature of the Drummond plan was the great attention paid to Kilkenny. In the early part of the nineteenth century, this town was an inland regional center of some significance although it declined steadily after the famine.

Even in the comparatively prosperous years before the famine, early development of Irish railways lagged behind that of England. Little capital could be acquired in Ireland itself, and British investors preferred the more remunerative fields of enterprise both in the home country and in the Americas. By the end of 1846, therefore, although parliamentary sanction had been obtained for the building of some 1,500 miles of railway, in effect only 123 miles had been opened. Such construction as had taken place, also, had been achieved partly with the help of state loans.

Poverty accompanying the famine greatly aggravated the difficulties of financing railway construction. But at the same time, it became clear that relief work was continually hampered by lack of rail communication. Toward the end of 1847, therefore, the government introduced a fresh series of loans to insure the progress of railway building; partly as a relief measure, and partly in the hope of improving permanently the areas concerned. Thus within a few years mileage of railroad in Ireland was considerably increased, and by 1852 the main outlines of the

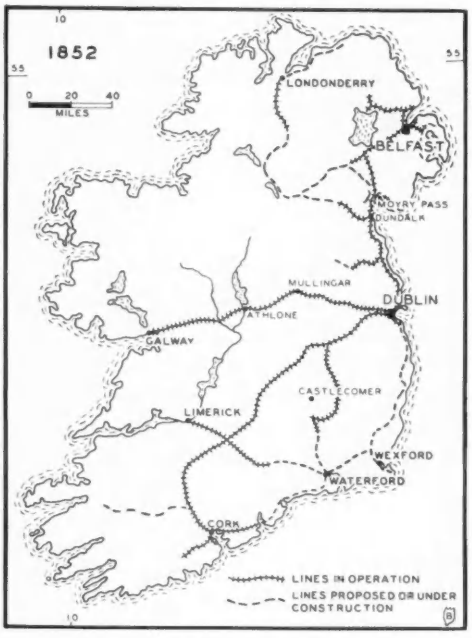

FIGURE 2.—Early trunk lines.

first railway system had appeared. These are shown on Figure 2.

The most striking feature of the 1852 map is development of trunk lines radiating from Dublin. The coastal route to Belfast, which had seemed too formidable to the Drummond Commissioners was eventually preferred to the inland one, as the engineers proved capable of using the Moyry Pass through the Carlingford Mountains. The route to Cork differed a little in its northern section from that suggested in 1837. It followed the obvious natural path across the limestone plain between the Castlecomer Plateau and the Armorican outliers which rise prominently on the west. Farther south, the westward loop was due to the difficulty of finding a suitable way through the striking east-west uplands of County Cork. Finally two north-south valleys were chosen, and the line was taken across the Old Red Sandstone arch by a narrow gap only 460 feet above sea level and down a comparatively easy gradient to Cork.

The two main trunk lines proposed in 1837 had thus been achieved by 1852, although the routes originally planned had suffered some modification. The third railway, however, the M. G. W. R. line to Galway, was a deliberate departure from the plans of the Commissioners. The details of the route chosen for the line are interesting. The track takes a sinuous course, following gravelly deposits wherever possible across the boggy country. The Act of Incorporation for this line authorized also the purchase by the railway company of the Royal Canal, and the first section of the line, which was opened in 1848, ran alongside the canal from Dublin to Mullingar. The completion of the line was checked by the severe distress in the rural areas after the famine of 1846, and work on it could only be continued in 1849 through a Treasury advance of £500,000. Athlone was chosen as the bridging point of the Shannon, because of the approaches of firm ground to the river on either side. Although, as has been mentioned, distribution and extent of bog land in Ireland has been no real impediment to development of a rail system, it is noticeable that bogs along the course of the Shannon have always prevented this river from exercising a centralizing influence in Ireland. This is clearly reflected in the railway pattern, the only point of convergence in Central Ireland being the bridge town of Athlone.

In Figure 2 there is also marked the fourth trunk railway which had been planned by 1852. This was the line from Dublin to Wexford and Waterford. Progress in building, however, was extremely slow.

By 1852 the essential features of the railway network had, indeed, made their appearance, and all construction after that date was really an amplifica-

tion of this fundamental pattern. The termini of the lines were ports with hinterlands tapped by railways. In the south and west, Wexford, Waterford, Cork, Limerick, and Galway had their links, actual or projected, with their tributary regions; in the north, Londonderry and Dundalk were connected, but the greatest development was around the rapidly-growing industrial district in and near Belfast. Dublin still remained the chief focus of the whole system.

Figure 3 shows the extent of development from the original framework which had been achieved by 1863. In Central Ireland there is noticeable the appearance of the two long feeder railways stretching out from the M.G.W.R. by tortuous routes skirting the fringes of the boggy country to Sligo and Castlebar (in Mayo) respectively. Farther east, subsidiary lines were built from Clonsilla to Navan and thence to Oldcastle. Although the work of separate companies, the eastern branch lines both followed the routes proposed by the Drummond Commission. The line from Clonsilla to Navan was built by the Dublin and Meath Company; this railway was later operated by, and then absorbed into, the M. G. W. R. The line from Navan to Oldcastle was built by the G. N. R. (I) (Great Northern Railway [Ireland]) Company. The opportunity for railway extension from Navan to Enniskillen via Cavan, which had been discussed by the Drummond Commissioners was blocked in the 'sixties by the existence of two new lines, one from Inny Junction to Cavan and a second from Cavan to Clones. The northern line was owned by the G. N. R. (I) Co., and the southern by the M. G. W. R. The two together linked the Central Lowland with Ulster by the Monaghan Gap.

In the south of Ireland, the most

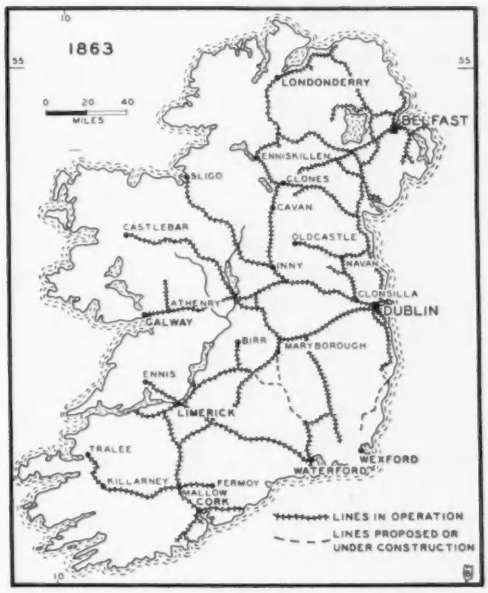

FIGURE 3.—Development of branch lines.

enterprising venture was the branch line from Mallow in County Cork to Killarney, which was opened in 1854. It followed a low-lying band of limestone, but the further extension to Tralee which was built a few years later climbed boldly 'round the Old Red Sandstone headland behind Dingle Bay. This piece of railway construction was an early attempt, and a successful one, to make the rugged country of Ireland accessible to tourists. In the same year the G. S. W. R. Company opened a hotel at Killarney, and thus helped to overcome the lack of good accommodation for travellers, which was one great obstacle to the development of the tourist industry in Ireland.

The other development which was noticeable in this third phase of railway construction was growth of branch lines behind the ports of the south and west, Waterford, Cork, and Limerick. These extensions of the rail network took place despite the fact that these towns were beginning to feel the effects of emigration, whether to the New World,

to Great Britain or to towns of the east littoral of Ireland.

The years after 1863 saw cessation of activity, except in the northeast, where industrialization advanced steadily. The standstill was most noticeable between 1877 and 1880, and was partly accounted for by a series of miserable harvests and accompanying hardship. Such amplifications of the railway system as belong to the twenty years between 1863 and 1883 are marked on Figure 4. The increase in mileage was not remarkable, but at the same time several gaps in the railway network were closed, and the railway map of 1883 has the appearance of a reasonably complete system, and thus differs from the immature pattern in the earlier Figures.

Construction of the following lines might be quoted as instances of comparatively short sections of railway built to complete the network: between Limerick and Tralee, between Kilkenny and Maryborough, between Waterford and Fermoy, between Ennis and Athenry, between Sligo and Enniskillen. By 1883, however, it seems to have been recognized that the limit of profitable extension had been reached, whether in the foothills of the Wicklow Mountains or in the bogs of the Central Lowland. The closing in 1878 of the line between Birr and Portumna Bridge in the Central Lowland after only ten years of operation is symptomatic of such a check to expansion. The northeastern region, of course, formed the exception to this general trend.

The year 1883 was important, because it saw the end of the "laissez faire" policy of railway building, and the substitution for it of more systematic planning by the State. This change was marked by passing of the Tramways and Public Companies Act. In the years immediately preceding this official measure, also, the vigor of the northeastern towns with their flourishing industries had begun to bring a quickening of economic life into the neighboring rural areas, and indirectly into other parts of the island.

The venture of the G. S. W. R. in developing the tourist industry in County Kerry has already been described, but in the 'seventies the rest of the country still remained inaccessible to holiday travellers. It was the rapid growth of Belfast which directed attention towards similar possibilities on the Antrim coast. The result was the opening up of beauty spots on the northeastern plateau to travellers by means of the narrow-gauge railways which are marked on Figure 4. One line was built between Ballymena and Larne in 1878 and another between Ballymoney and Ballycastle in 1880. The former catered especially to English and Scottish visitors, and the seasonal work in hotels which developed from the railway facilities brought additional means of earning to the peasantry of the northeast.

Equally important was the legislation sanctioning the Light Railways, of which the first measure formed part of the Tramways and Public Companies Act of 1883. The other two pieces of legislation which affected development of this kind of rail communication were (1) the Light Railways Act of 1889 which gave wider powers to the Board of Works as a result of the report of the Allport Commission, and (2) the Railways (Ireland) Act of 1896, by which the Burtonport and Carrdonagh extensions to the L. L. S. R. were built. Altogether 603 miles of line were constructed under the three Acts. As early as 1871, an Act had been passed to encourage building of steam-tramways, but before any further steps had been taken, the economic distress of the 'seventies which affected the greater part of the country had frightened pos-

sible speculators in this kind of venture. The legislation in and after 1883 is evidence of the change in governmental policy already described. Where economic insecurity had damped private enterprise, the serious condition of the Irish peasantry had awakened official concern for the transport and communication system. The Light Railway Acts are therefore associated with the attempts at agrarian reform in the eighties.

Under the 1883 Act, the baronies through which the new lines were to run, or those near enough to be affected thereby, guaranteed the dividend, usually four or five per cent. Whatever the railway failed to earn by its net profits was levied by a tax. The areas concerned thus obtained the benefit of the railways by taxing themselves, but in some very poor districts further assistance was granted by the Treasury.

Such lines were built in several inland districts, more particularly along the rugged western and southwestern coasts. They brought to the latter region a new source of income from tourists, and also facilitated marketing of fish. Notably parts of County Donegal were opened up by narrow gauge lines, especially after the establishment in 1891 of the Congested Districts Board. The standard light gauge railways from Londonderry and Carrowen, and from Strabane to Stranorlar were converted to the 3′ gauge in 1887 and 1894 respectively, owing to the difficulties of transshipment. Equally poor but much less rugged were the congested districts of western Connacht, which was another important scene of light railway activity after the tragic autumn of 1890. The prevailing flatness of most of this area made possible building of lines which, though of lighter construction and less elaborate signalling than normal railways, were nevertheless on the 5′ 3″ gauge. This building arrangement was much preferred and partly subsidized by the larger companies with whose systems they were connected. Of these new standard Irish gauge lines, two were built to the extreme west coast at Achill and Clifden. In conjunction with the M. G. W. R. hotels opened at Galway and Mallaranny in 1897, they made possible that company's famous Connemara tour. Elsewhere in Connacht opportunity was taken when building lines through purely grazing country to close the two gaps that existed between Tuam and Coollooney. These pieces of construction formed an incursion by the Waterford, Limerick and Western Railway into M. G. W. R. territory which was much resented by the latter. In 1901 the G. S. W. R. Company absorbed the W. L. W. R. concern. Movements of temporary and permanent migrants were facilitated by the railways in some parts of the country, since every train has carried its travellers to western Great Britain or

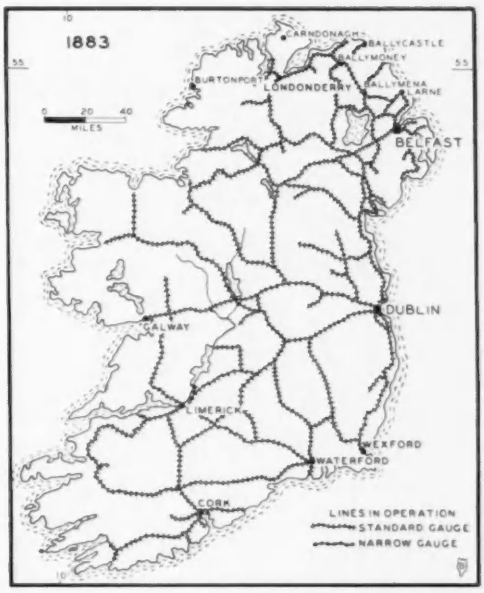

FIGURE 4.—The map illustrates the period when private enterprise in railway building was giving way to a policy of state planning.

FIGURE 5.—Maximum extent of the Irish Railway System (1920). The Listowel and Ballybunion *lartigue* monorail is shown as narrow gauge. All other lines so marked were of the 3′ gauge.

to the New World. Again the railways brought benefits to many of the poorer western districts, since eggs, poultry and other products could more easily be taken to ports and fetch a better price.

Several standard gauge light railways were also built in the southwest, and another was opened in County Down from Downpatrick to Ardglass. The list is completed by a medley of very diverse narrow gauge tramways. Both gauges, standard and narrow, had their advantages. The former permitted through running, while the latter was less costly to build. Narrow gauge railways were, however, apt to be unsafe in exposed areas, and serious gale accidents occurred on the Burtonport and Tralee and Dingle lines. The controversy between the two systems is not now of importance, for all light railways, on account of their speed restrictions, are especially vulnerable to road competition and are gradually being compelled to close down. On the whole they have never been so successful as was expected, and although they undoubtedly helped to open up some of the remotest areas, they have in some ways been expensive luxuries.

Despite the fact of increasing prosperity in Ireland between 1900 and 1914, very few railways were built during these years. In 1906, a new cross-channel service was opened between Fishguard and Rosslare, and in connection with this the G. S. W. R. Company built the line between Rosslare and Waterford. As a further part of this scheme, short connecting lines were built through the centers of Waterford and Cork. The geographical sites of both parts are similar, and the way in which numerous independent concerns had built lines converging on them accounted for the lack of connection between the different systems. Although details of sites were less similar in parts of Dublin, Belfast, and Londonderry than in Cork and Waterford, the same problem had occurred in these three cities. Several lines were built through Dublin, notably the City of Dublin Junction Railway in 1890 which was of great importance for trans-Atlantic mail services. Similar developments had also taken place at Belfast and Londonderry.

During this period the increasing importance of tourist trade encouraged completion of the line between Newcastle and Ballyroney in the Mourne Highlands. The last normal line to be opened before 1914, however, served only the small market towns of Keady and Castleblayney in Armagh and Monaghan. The original proposal had been to complete the link between Armagh and the M. G. W. R. at Kingscourt in County Cavan along the route suggested in 1837, but the G. N. R. opposed the scheme so violently that only the section from Armagh to Castleblaney was built.

During the 1914–1918 war it was thought necessary to introduce state control of Irish railways. Within that period maximum development of the railway system was attained with building of the colliery lines to Wolfhill and Castlecomer in Kilkenny, and with the short extension of the Cavan and Leitrim railway to the Arigna coalfield in Roscommon. This farthest extent of the railway system is shown in Figure 5, which illustrates rail communications in 1920. Amount of transport activity achieved in these years could not be maintained, however, and a decline in the use of railways was noticeable almost immediately.

This depression began with the closing of a number of railways in the border country between the Free State and Northern Ireland owing to political disturbances there. It was, however, only a temporary setback, since, with the exception of the relatively new section of railway between Keady and Armagh, all the lines were later reopened. But a few years later, road transport began to compete with that of railways, and this development led to a much more widespread and permanent decline in the railway system. Figure 6 shows the serious extent to which the light railways were affected, but the main lines also suffered severely. In Ireland demand for transport of really heavy goods is comparatively small, hauls are on the whole short, and cheapness is often preferable to speed. These circumstances enable road transport to compete much more vigorously with railways than in England.

This account of the intermediate stages in the evolution of the Irish railway system explains the appearance of the existing network of lines in Ireland, which without interpretation might seem confused and meaningless. Each of the figures shows the introduction of a new phase of building, or, in the last instance, of a contraction in activity. These phases developed mainly in response to changing economic conditions. At the beginning of the railway era in 1837 all routes led to Dublin, but after 1852, Belfast grew up rapidly as a rival, absorbing together with its satellite towns many of the people emerging in numbers from the poverty-stricken countryside. Other ports also developed as the focal points of railway transport, since energies of Ireland were largely directed toward export of food to industrial Britain. This trend favored the eastern ports rather than the Atlantic ports of Galway and Limerick, although their decline is not very apparent from the accompanying maps. Development of transverse railways, linking the main lines, converted the simple radial patterns focussing on the two largest ports, Dublin and Belfast, into webs or nets, but in the cases of the other towns with their smaller hinterlands this second stage was never reached. The web

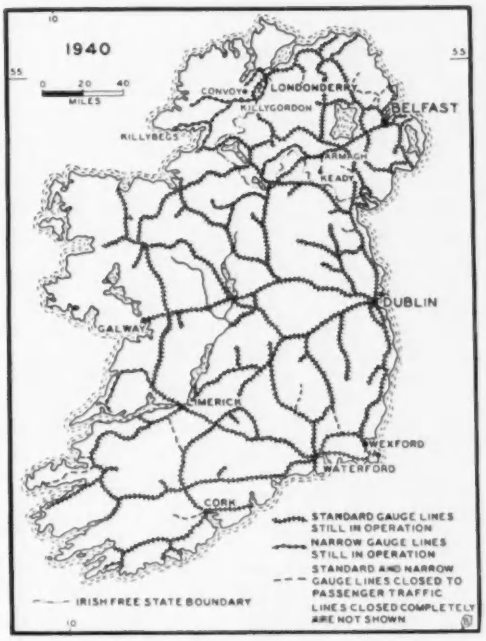

FIGURE 6.—Closing of the branch lines.

centering on Dublin, which has always been the outstanding export and import city for central and southern Ireland, remained widely spaced as befitted a predominantly rural country. Belfast, on the other hand, served throughout a smaller but more highly industrialized region, and the mesh of railway network became proportionately closer. The symmetry of the Belfast web is, however, considerably distorted by disposition of Lough Neagh and the nearby upland massifs. After 1883 help afforded by the state to light railway building artificially prolonged the period of building expansion, by extending rail transport to areas hitherto considered unprofitable. The recent closing of many of these lines, however, has made it clear that this form of railway development was really superfluous, although obviously the planners could not have anticipated extent of growth of bus and lorry transport which has superseded the light railway.

These features of railway evolution are compressed into the existing railway map, and they are also complicated by the other set of influences which are the outcome of physical features. For example, sweeping curves of the routes proposed by the Drummond Commissioners were replaced in later maps by more angular outlines which conformed to the east-west pattern of the Armorican highlands of Munster. Again in County Donegal, the northeast–southwest trend of the Caledonian folds impressed itself upon the appearance of the railway map.

The upheaval caused by the partition in 1922 has not resulted in any appreciable changes in the railway pattern, although the "economic watershed" between Dublin and Belfast has certainly been accentuated. Suggestions have been made, however, to provide a new port for County Donegal, since existence of the frontier obstructs the traditional outlet through Londonderry. The scheme involves deepening Killybegs Harbor on the western arm of McSwyne Bay (Donegal Bay), and building of a narrow gauge line to connect Convoy in the Deele Valley with Killygordon in the Finn Valley.

It is plain from an examination of the Irish railways that extent and pattern of the network are the outcome of nineteenth century conditions rather than an effective support to present economic development. The closing of some branch lines is only partial recognition of the out-of-date character of much of the Irish rail communication system. Unless, therefore, the governments in Dublin and in Belfast have in mind a carefully planned and far-sighted policy of railway maintenance and exploitation, the network will tend to become more and more the unserviceable relic of a bygone and discredited era.

CURRENT TRENDS IN CALIFORNIA ORCHARDS AND VINEYARDS

Peveril Meigs, III

CALIFORNIA produced 45 per cent of the total United States tonnage of orchard and vineyard fruits and nuts in 1938. Of the twenty such crops tabulated in the annual reports of the United States Department of Agriculture, California led the nation in fifteen. The following table gives details.

TABLE I*

FRUIT AND NUT PRODUCTION IN CALIFORNIA, 1938

Crop	*Production, short tons*	*Per Cent of Total U. S. Production*	*Rank of Calif. in U. S.*
Grapes	2,331,000	93	1
Almonds	12,100	99	1
Peaches	500,040	40	1
Figs	43,500	97	1
Olives	40,000	99	1
Plums and Prunes	285,000	77	1
Apricots	176,000	85	1
Pears	293,775	36	1
Apples	178,440	6	5
Cherries	28,800	21	1
Walnuts (English)	44,000	90	1
Oranges	1,832,000	54	1
Lemons	406,068	100	1
Grapefruit	72,960	4.5	4
Avocados	12,500	85	1
Dates	3,510	95	1
Limes, filberts, pecans	Negligible	.....	..
California total	6,259,693T.	45%	1

*Based upon provisional tables and conversion values from U. S. Department of Agriculture: Agricultural Statistics 1939, Washington, 1939.

General figures such as the above give no hint of the regional specialization within California, nor of the pronounced changes that are occurring in the acreage of some crops. It is the purpose of the present article to provide, through a series of maps, a concise graphic analysis of regional distributions and trends of California orchards and vineyards. Source of material for the maps is an exhaustive survey made in 1936 by the California Coöperative Crop Reporting Service, assisted by the United States Department of Agriculture and Works Progress Administration. (United States Department of Agriculture, Agricultural Adjustment Administration: Statistical Publication No. 1, California Fruit and Nut Acreage Survey 1936, Washington, 1938.) This survey, more detailed and accurate than any other previously undertaken, gives by counties for every important variety of each type of crop, figures of bearing and non-bearing acreage, acreage of new plantings each year for a number of previous years, and ages used in determining bearing acreage. The report includes more varieties of crops than the United States Census, and also differs from the Census in giving acreages rather than numbers of trees: a decided advantage geographically.

REGIONAL DISTRIBUTION OF ORCHARDS AND VINEYARDS

The principal orchard and vineyard districts are shown in Figure 1. Outside of these districts the environment is largely unsuited to these crops because of roughness of land surface, unsuitability of soil, insufficiency of water for irrigation, or coldness of climate. The distribution and regional importance of each type of crop is shown in Figures 2 to 19. All fruit and nut crops covering more than 20,000 acres, and a few of smaller acreage, have been mapped. In these maps the area of the circle is proportional to the acreage of the crop in each county where there is significant acreage.

The greatest acreage of orchards and vineyards occurs in the eastern side of the Sacramento and San Joaquin valleys, with hot dry summers well suited to fruit drying, surface or underground irrigation water available from Sierran sources, moderate rainfall in winter, and occasional severe frosts. Here centers the grape, with largest acreage of any California fruit. Raisin and table

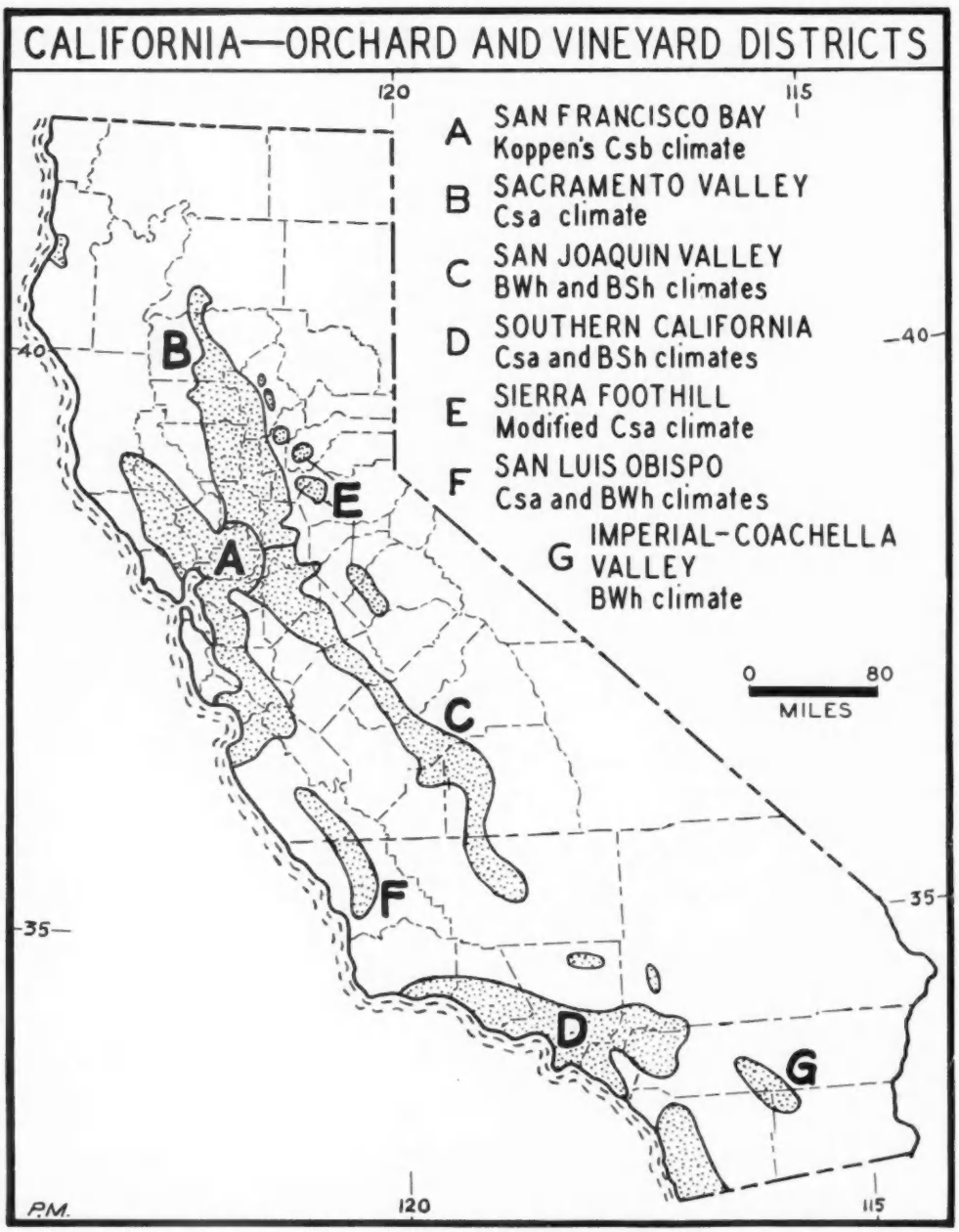

FIGURE 1.—Distribution of orchard and vineyard districts of California represents an adjustment to conditions of terrain and climate as well as transportation, markets, and other cultural factors which this map indicates, and which the text attempts to demonstrate further.

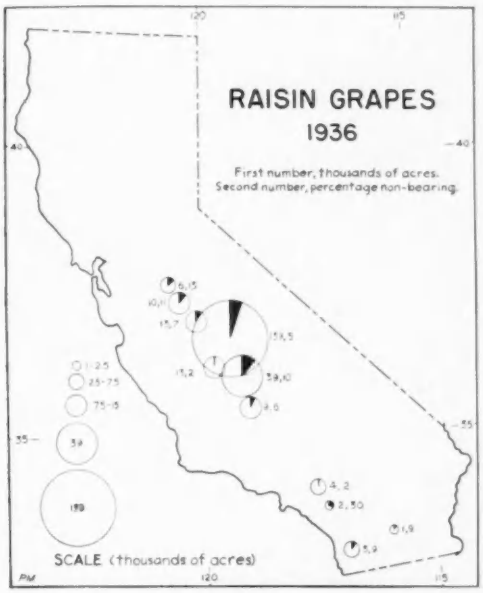

FIGURE 2.—Raisin grapes are concentrated in the southern San Joaquin Valley. Dynamic index (percentage of acreage non-bearing) is positive both in 1936 and in 1939, indicating current upward trend.

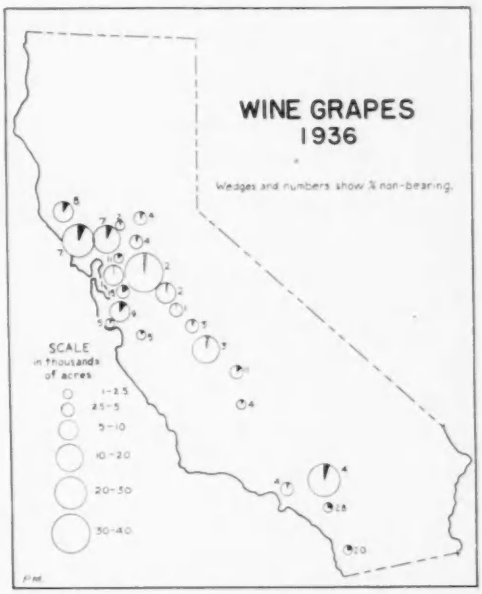

FIGURE 3.—Acreage of wine grapes is scattered in San Joaquin Valley, San Francisco Bay district, and Southern California. The southward and westward trends suggested on the map for 1936 have not persisted. In 1939 the dynamic index is negative except in San Bernardino County in the south.

grapes are concentrated in the San Joaquin Valley, but wine grapes, with their many specialized requirements, are important also in the Coast Ranges and Southern California. Peaches are widely distributed in the Great Central Valley, with clingstone or canning peaches emphasized in the north and freestone peaches in the south. Olives are important in both segments of the Valley, figs center in the southern part, almonds in the northern. A secondary almond district occurs in the south central Coast Ranges.

A limited district of cooler climate, consisting of flat uplands in the northern Sierra Nevada foothills from 1,000 to 3,000 feet in elevation, contains the majority of the plum and an important percentage of the pear acreage of the state.

The San Francisco Bay district includes valleys and their lower slopes oriented around San Francisco and Monterey bays, and the adjacent Sacra-

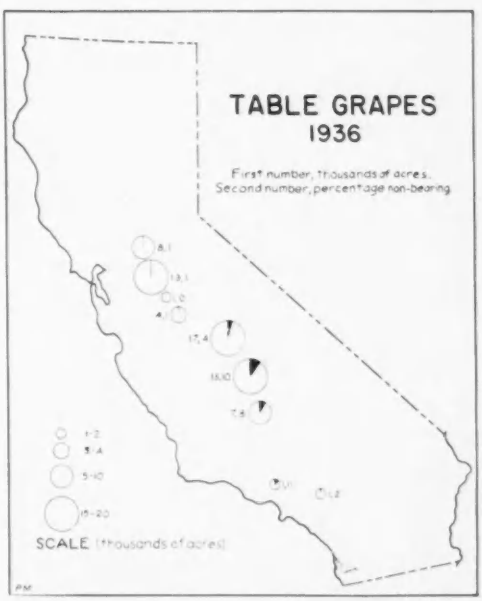

FIGURE 4.—Table grapes are chiefly in San Joaquin Valley. The map shows positive dynamic index in southern part of the Valley, negative in the northern, in 1936. By 1939 the index has risen still higher in the south, and has about reached the neutral point in the north.

mento–San Joaquin delta. Relatively cool summers, with frequent fogs, distinguish this district. As might be expected, such crops as apples and pears here have their chief acreage, the former concentrated in two centers near the coast at the northern and southern ends of the district, and the latter showing an offshoot into the lower Sacramento Valley and Sierra foothills. Prunes, apricots, and cherries, important

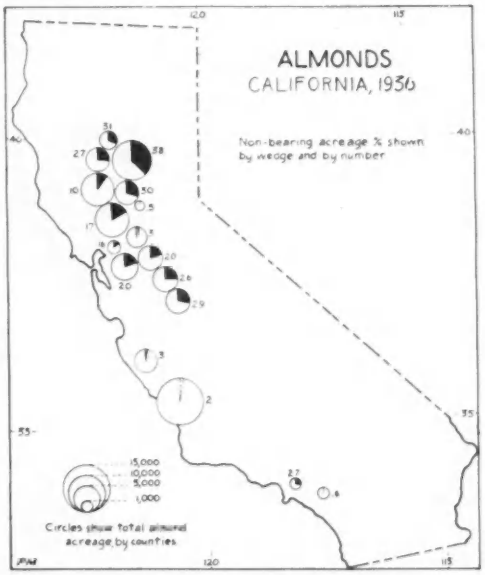

FIGURE 5.—A striking expansion of almonds is in progress in Sacramento and northern San Joaquin valleys, contrasted with a negative condition in the San Luis Obispo district. Expansion in the interior continues with unabated vigor in 1939, in spite of severe winter floods, which led to a loss of about a thousand acres of almond trees in Butte County alone in 1938.

throughout the district, are stressed particularly in Santa Clara Valley, just south of San Francisco Bay, and have important acreages also in the Sacramento–San Joaquin Valley.

The Southern California district consists principally of alluvial valleys opening upon the Pacific Ocean. Here the winters are milder than in any other part of California, and here is concentrated the chief acreage of citrus fruit.

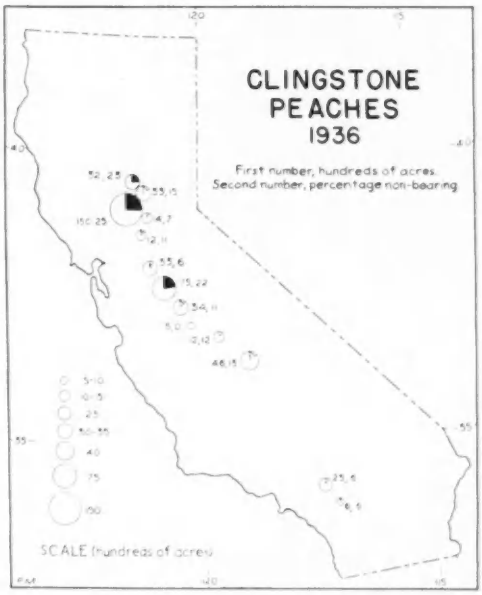

FIGURE 6.—Principal centers of clingstone peaches, in Sacramento and northern San Joaquin valleys, were barely holding their own in 1936. In 1939, a markedly positive index had developed in the three leading Sacramento Valley counties.

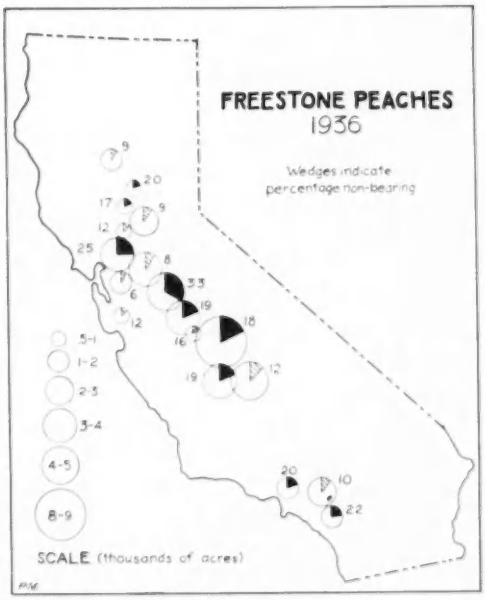

FIGURE 7.—The center for freestone peaches is the Great Central Valley. The dynamic index is slightly positive in 1936 and 1939. With the bulk of the orchards less subject to flooding, the neutral point is lower than for clings.

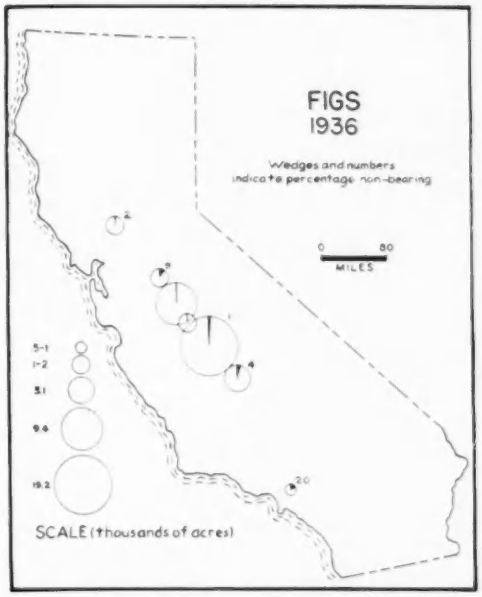

FIGURE 8.—Figs are grown chiefly in San Joaquin Valley. They showed a decline for 1936 and 1939.

Lemons, most sensitive of the three major citrus fruits, are most narrowly confined to the littoral; oranges, particularly the hardier, navel oranges, extend farther inland, with one important area even in the San Joaquin Valley; and grapefruit reach their best development in the irrigated interior desert of the Coachella Valley. The avocado, highly frost-sensitive, flourishes most in western San Diego County, the most frost-free corner of California. English walnuts have their major acreage in Southern California, with important secondary development in the San Francisco Bay district.

The hot desert of the southern interior, already mentioned as the chief source of grapefruit, also contains the California date groves.

RECENT STATEWIDE TRENDS

ECONOMIC GEOGRAPHY has called attention to overplanting of fruits in California immediately after the first World War, when profits in fruit were high. (Hodgson, R. W.: The California Fruit Industry, ECONOMIC GEOGRAPHY, 1933, pp. 354–355.) From the post-War peak of acreage, a decline set in and continued to the bottom of the depression, since which time there was a small increase until 1938, when the acreage was still at least 13 per cent below the post-War peak. A slight drop in acreage has occurred from 1938 to 1939. Not all crops reached their peaks in the post-War period. The peaks of planting activity can be grouped into three main periods: pre-War, post-War, and early depression. Apples, prunes, and olives belong to the first period; grapes, almonds, peaches, figs, plums, apricots, pears, walnuts, and cherries experienced their planting boom in the post-War period (1919–24); and the subtropical fruits of Southern California, lemon, orange, grapefruit, avocado, and date, reached their peaks of activity in early years of the depression (1931–1933). Almonds have ex-

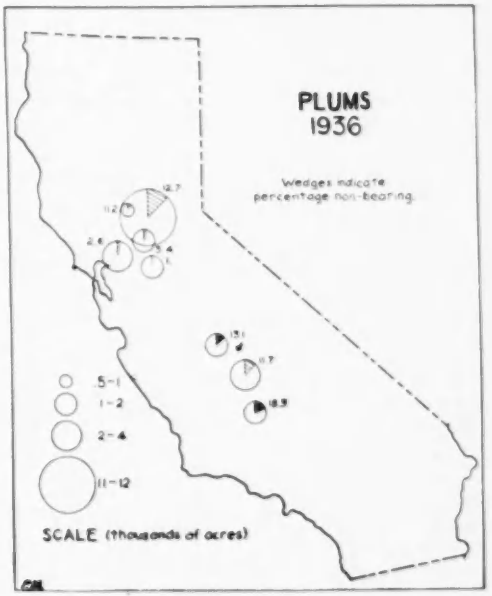

FIGURE 9.—The center for plums is in the northern Sierra Nevada foothills. The index for them is negative, except in San Joaquin Valley where a slight positive index exists both in 1936 and 1939.

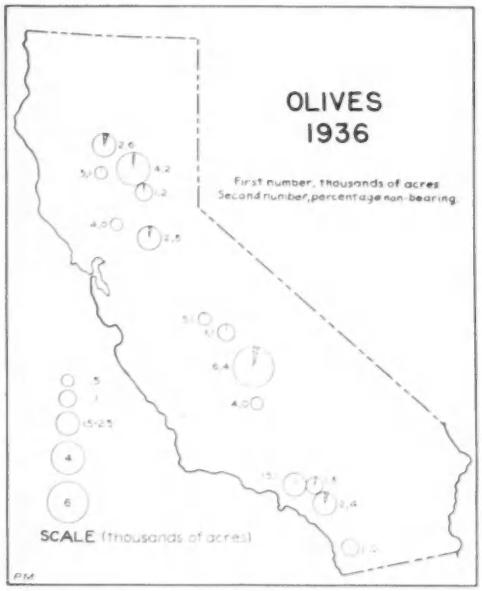

FIGURE 10.—Olives are found in the hot ends of the Great Central Valley. A smaller development is found inland in Southern California. They show a general state of decline for 1936 and 1939. The peak of olive planting was reached before the World War.

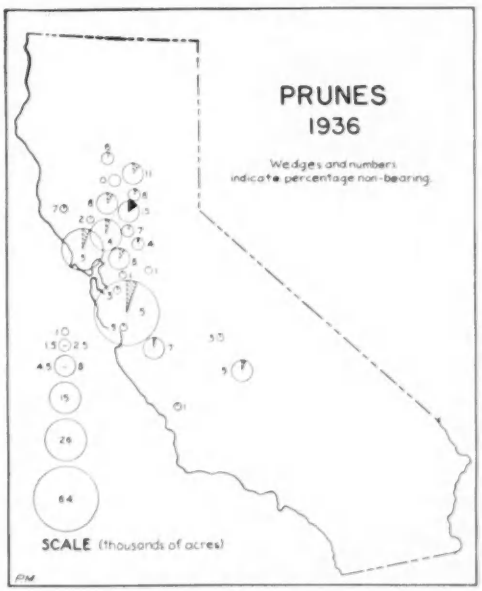

FIGURE 11.—Prunes are concentrated in the San Francisco Bay district, with an offshoot in Sacramento Valley. The general negative index of 1936 continues to prevail in 1939. Only Sutter County, in the Sacramento Valley, shows approximate stability.

perienced a sustained new boom since 1934. Most of the changes in rate of planting are associated with actual and prospective prices and profits. Crops which have maintained high prices have continued to expand.

In Table II, columns 5 and 6 summarize changes of acreage from 1930 to 1936, and 1936 to 1939. It will be observed that the subtropical fruits of Southern California increased in acreage from 1930 to 1936, and that lemons, oranges, and avocados continued to expand to 1939. Outside of Southern California, almonds were the only crop that increased acreage from 1930 to 1936, and this trend was sustained to 1939. Grapes and peaches reversed their trend and increased in acreage during the second period. Almonds and lemons led all other crops in rate of expansion in the last period. Their favored position resulted from the maintenance of good prices throughout the depression, in the case of almonds due to the fact that American production has not yet reached normal consumption requirements, and in the case of lemons due to the near-monopoly of the growers' organization in the face of large crops.

Statistics quoted for years other than 1936 are based upon four bulletins, "Acreage Estimates of California Fruit and Nut Crops," by the California Coöperative Crop Reporting Service, Sacramento, for the years 1927–1932, 1937, 1938, and 1939 respectively. The accuracy of successive bulletins is steadily increasing, and the already superior quality of California orchard statistics will be still further increased as a result of passage in 1939 of a law requiring that in the future all new plantings or removals amounting to an acre or more must be registered at once by the farmer.

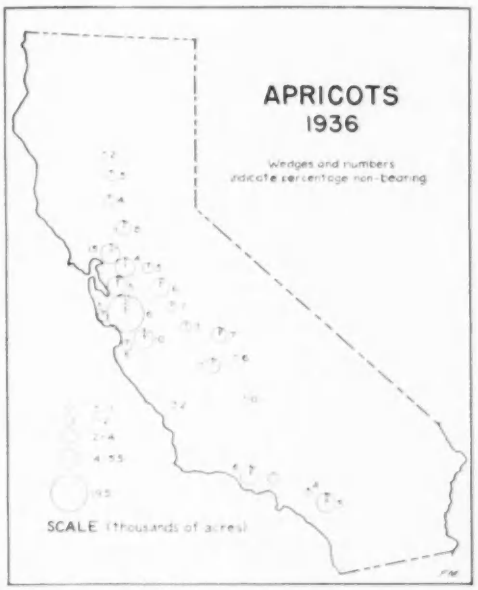

FIGURE 12.—Apricots have their center in San Francisco Bay district, and secondary development in all districts with hot summers. Negative indices in 1936 and 1939 are evident. Their peak of planting came after the War.

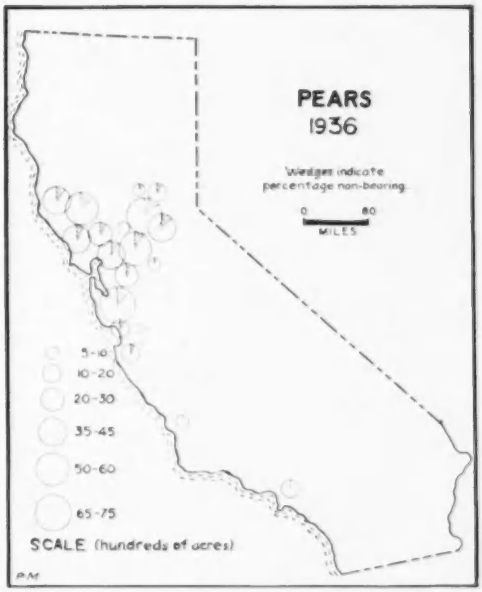

FIGURE 13.—Pears are concentrated in the relatively cool areas of San Francisco Bay district, mid-Central Valley, and Sierra Nevada foothills. The negative dynamic index of 1936 becomes still lower in 1939.

TABLE II

ACREAGE AND TRENDS OF MAJOR ORCHARD AND VINEYARD CROPS OF CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	
Crop	*Acreage, 1936*	*Years Before Bearing*	*Neutral Point (approx.)*	*Per Cent Acreage Change*		*Dynamic Index (per cent non-bearing)*		*Current Trend, According to:*		*District with Chief Acreage (see Fig. 1)*	
				1930 to 1936	*1936 to 1939*	*1936*	*1939*	*Dynamic Index, 1939*	*Rate of Planting, 1939*		
Raisin Grapes	243,500	3	3½	–	+4.5	6.4	5.6	+	+	C	Central Valley and margins
Wine Grapes	172,097	3	3½	–	+ 1.7	5.3	3.3	±	–	A, C, D	
Table Grapes	81,424	3	3½	–	+ 4.4	4.7	6.9	+	+	C	
Almonds	84,259	6–7	8	+	+ 9.9	17.6	20.7	+	+	B	
Clingstone Peaches	50,592	4	18	–	+ 4.0	17.2	26.4	+	±	B	
Freestone Peaches	47,485	4	15	–	+ 4.4	16.9	18.0	±	±	C	
Figs	39,563	7	22	–	– 3.8	3.2	2.6	–	–	C	
Plums	27,966	4	13	–	– 4.1	10.8	6.4	–	–	E	
Olives	25,966	7	16	–	– 7.0	2.8	2.4	–	–	B, C, D	
Prunes	165,426	6–7	15	–	– 3.8	6.0	5.2	–	–	A	San Francisco Bay
Apricots	78,609	5	17	–	– 0.3	6.2	6.5	–	–	A	
Pears	59,540	6–7	21	–	– 9.3	9.6	5.4	–	–	A	
Apples	40,234	7	20	–	– 4.2	6.7	6.0	–	–	A	
Cherries	16,731	6	17	–	–14.9	13.1	7.3	–	–	A, C	
English Walnuts	134,491	7	18	–	– 0.5	14.9	8.7	–	–	D, A	Southern California
Oranges	238,000	5	8½	+	+ 4.9	10.0	5.5	±	–	D	
Lemons	61,179	5	6	+	+13.3	30.1	15.3	+	+	D	
Grapefruit	19,645	5	11	+	– 5.4	20.4	11.2	±	–	G	
Avocados	14,114	5	17	+	+ 0.9	27.8	7.5	–	–	D	
Dates	3,588	6	17	+	– 0.6	49.4	14.0	–	–	G	

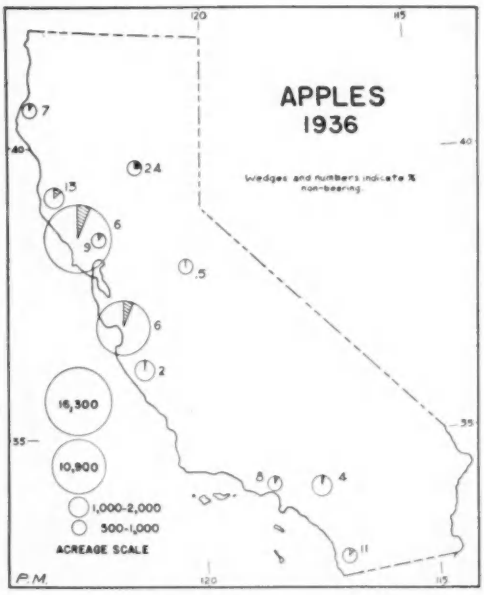

FIGURE 14.—Apples are located in two particularly cool areas near the coast in Sonoma and Santa Cruz counties. Dynamic index is negative. It is a significant sign of current trends that oranges exceeded apples in tonnage of production in the United States in 1938.

CURRENT STATEWIDE TRENDS

Past trends do not necessarily indicate current trends. Indications of current trends are given by the rate of current plantings and by the proportion of non-bearing acreage to total acreage. The ratio between non-bearing and total acreage I have called the "dynamic ratio" or "dynamic index" since it provides an index to current activity. (Abstract in *Annals of the Association of American Geographers*, March, 1939, pp. 82–84.) In Table II, Columns 7 and 8 give the dynamic indices for California crops in 1936 and in 1939. If the proportion of non-bearing trees is more than enough to replace loss of old trees each year, current expansion of bearing acreage is indicated, and the dynamic index may be spoken of as positive. To analyze current trends, therefore, one should know what proportion of non-bearing trees must be maintained in order to perpetuate the orchard. This proportion denoting stability, or the "neutral point," is listed in Column 4 for each crop. The neutral point was estimated on the basis of actual acreage changes that have occurred following earlier indices rather than on the basis of theoretical normal longevity of trees. Because of incompleteness of past records, my figures of the neutral point must be regarded as approximate and provisional, subject to refinement in the future as additional evidence becomes available.

In general, the longer the life expectation of a given type of tree and the shorter the time required for a newly-planted tree to come into bearing, the lower will be the neutral point. Thus, grapes, which live long and come into bearing three years after planting (Table II, Column 3) are stabilized with a dynamic index of about 3½ per cent,

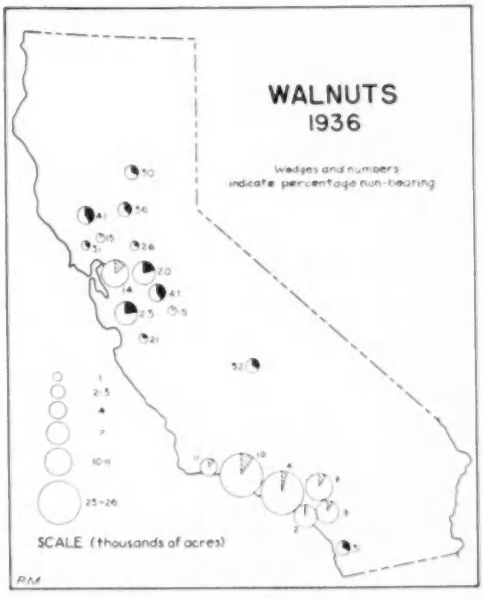

FIGURE 15.—Southern California is still the chief district for walnuts, but the San Francisco Bay district is of great and increasing importance. By 1939 negative dynamic indices of Southern California had become still lower, and the San Francisco Bay indices had become neutral or slightly negative. Several Central Valley counties were still positive in 1939.

while prunes, shorter-lived and requiring six or seven years to reach bearing age, have a neutral point of about 15 per cent. Unusual excessive losses of trees would raise the neutral point, by necessitating larger new plantings to maintain the acreage of the orchard. Thus, excessive pulling of old peach trees during the depths of the depression, and losses of cling peach trees from floods in the winter of 1937–1938, have operated to raise the neutral point of California peaches above what would otherwise be the case. It is likely that long-time records would show regional differences in neutral points, too.

A comparison of the actual dynamic index of 1939 with the neutral point for each type of crop shows that the indices for raisin grapes, table grapes, almonds, clingstone peaches, and lemons are positive, thus forecasting increase of bearing acreage; wine grapes, freestone peaches, and grapefruit have approximately neutral indices; and the other crops listed have negative indices and are undergoing decline. Finally, the rate of new plantings in 1939 confirms the trends indicated by the dynamic index except that the indices of wine grapes and grapefruit become definitely negative, and all peaches are approximately stabilized (Table II, Column 10). On the whole, then, shrinkage is under way for most California orchard and vineyard crops. Crops in the Great Central Valley show greatest prospects of expansion; while the San Francisco Bay district, on the contrary, shows prospective decreases for all of its major fruits.

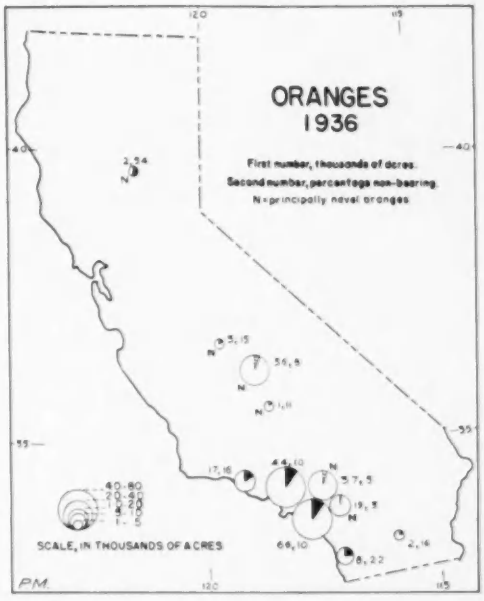

FIGURE 16.—Valencia oranges are concentrated in the Southern California coastal area, while navel oranges predominate farther inland. Coastal counties show a positive dynamic index in 1936, but by 1939 only Ventura County, at the western margin of the district, retained a strongly positive index. On the whole, approximate stability is indicated.

CURRENT INTER-REGIONAL TRENDS

Generalizations for statewide trends of acreage ignore shifts that may be occurring between districts within the state. Such shifts are graphically suggested in the accompanying maps by means of wedges proportional to the non-bearing acreage in each county. Black wedges indicate positive dynamic indices, while shaded wedges indicate negative, in relation to the neutral points listed in Table II, Column 4. Since the maps, with their explanatory texts, speak for themselves regarding trends of 1936 and 1939, attention will be called here only to a few outstanding generalizations. (For a more detailed theoretical discussion of this type of map see my article, "A New Index for the Analysis of Regional Trends," *Scottish Geographical Magazine*, May, 1939, pp. 161–170.)

In the Great Central Valley and its margins, the chief producing centers exhibit on the whole the largest dynamic indices, indicating a condition of adjusted localization. A slight trend coastward indicated for wine grapes

had disappeared by 1939. Almonds are undergoing a striking expansion in the Sacramento Valley, compared with the negative condition in the San Luis Obispo district of the Coast Ranges. While it is likely that the Valley requires a somewhat greater rate of planting than the San Luis district, due to occasional loss from floods, the high indices in the Valley do represent a real upward trend in almond acreage. Because of the promotional character of much planting in the San Luis area, concentrated largely in a few post-War years, with few new recent plantings, the dynamic index here is very low, and declining acreage is in prospect. Peaches show considerable evidence of local readjustments in progress, with biggest centers growing still bigger, especially for cling peaches, where canneries tend to give existing centers an advantage. Figs, olives, and plums are declining,

FIGURE 17.—Lemons are concentrated near the immediate coast of Southern California. They constituted in 1936 and 1939 the most rapidly expanding major orchard crop of California. Dynamic indices are particularly huge at the extremities of the district. Positive trends continue in 1939, though at a slightly less rapid rate.

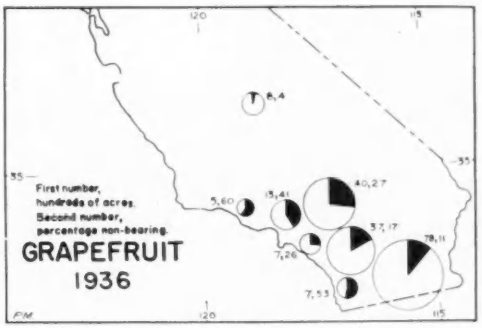

FIGURE 18.—Grapefruit show positive indices in 1936, higher in the secondary district near the coast than in the primary district in the desert to the east. In 1939 the interior acreage was shrinking and the coastal was in approximate equilibrium. A decrease in total acreage and in dynamic index followed the sharp price drop and loss of trees by freezing in 1937. Further decrease is likely.

though the latter show a small spurt southward.

Types of orchards whose chief acreage lies in the San Francisco Bay district are all shrinking, in major as well as minor localities. This downward trend is partly due to changes in consumer habits; partly, in the case of apples and pears, to competition with other districts nearer the eastern markets; and partly, especially in the case of prunes and apricots, to declines in the export markets.

Southern California, both coastal and desert, showed vigorously expanding orchards in 1936, except for a marked trend of walnuts toward the San Francisco Bay district; a trend that continues mildly in 1939. The striking increase in lemons is particularly noticeable toward the northern and southern edges of its coastal belt. The dynamic index of avocados and dates, positive in 1936, had become negative by 1939 due to a sharp drop in plantings.

Occasionally a very large dynamic index is found in a minor marginal district, as illustrated in the case of oranges and lemons in the Sacramento Valley in 1936, Figures 16 and 17. This

situation indicates not a shift toward a newly discovered favorable area of production, but rather a replanting following great losses of trees in the severe freeze of 1932.

MICRO-TRENDS

Published statistics are not available to localize trends in areas smaller than counties. The unpublished records of the Census Bureau, however, give figures of bearing and non-bearing trees by minor civil divisions. While the present article makes no attempt to cover the state in such detail, it is felt worthwhile to illustrate a possible use for these detailed figures in detecting internal changes that may be occurring in a fruit district. The Fresno grape district is here chosen as an example. In Figure 20 is mapped the dynamic index as calculated from figures of nineteen minor civil divisions from the federal farm census of 1935. It becomes at once apparent that in this district expansion is progressing in the central rather than the peripheral areas, except where an offshoot of activity projects into Tulare County to the southeast.

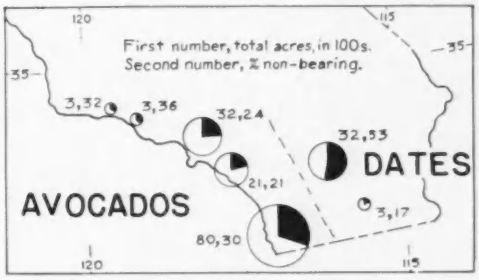

FIGURE 19.—Avocados are centered in the southern littoral of San Diego; dates in the desert farther inland. Both crops show positive indices in 1936. By 1939 the index of each had shrunk to a negative value following maturation of the trees planted during the 1929–1933 planting boom.

MINOR ORCHARD TYPES

For the sake of completeness, brief mention should be made of fourteen minor fruits and nuts, none of them totalling as much as 3,000 acres. Their acreage, location, and trends are summarized in Table III. Most striking tendency indicated is that of great planting activity among subtropical fruits in the San Diego area of the Southern California district. All six of these fruits experienced a planting boom between 1930 and 1935. While it seems likely that the dynamic index

TABLE III

ACREAGE AND TRENDS OF MINOR ORCHARD TYPES, CALIFORNIA

Crop	*Acres, 1936*	*Years to Bearing*	*Dynamic Index, 1936*	*Dynamic Index, 1939*	*Current Trend**	*Chief District (Fig. 1)*
Quinces	232	6	10.2	5.0	− −	Scattered
Pecans	1,852	8	85.9	54.9	+ −	G
Chestnuts	589	8-9	68.8	46.0	+ −	A
Filberts	170	5	46.4	22.8	+ −	Scattered
Nectarines	2,664	4	18.7	25.0	+ +	C (S.)
Pomegranates	721	4	2.4	1.6	− −	C (S.)
Persimmons	1,560	5	6.2	2.1	− −	D
Loquats	147	4	2.0	....	−	D
Limes	456	5	84.8	42.0	+ +	D (S. Diego)
Passion Fruit	75	1	7.4	....	?	D (S. Diego)
	Trees, 1936					
Cherimoyas	9,412	5	70.7	....	+	D (S. Diego)
Sapotes	2,549	6	69.0	....	+	D (S. Diego)
Papayas	1,720	1	1.2	....	−	D (S. Diego)
Mangoes	282	4	39.0	....	+	D (S. Diego)

*First sign, trend as indicated by dynamic index; second sign, trend as indicated by new plantings made in 1939. Where later evidence is not available, a single sign is used to indicate trend according to dynamic index of 1936.

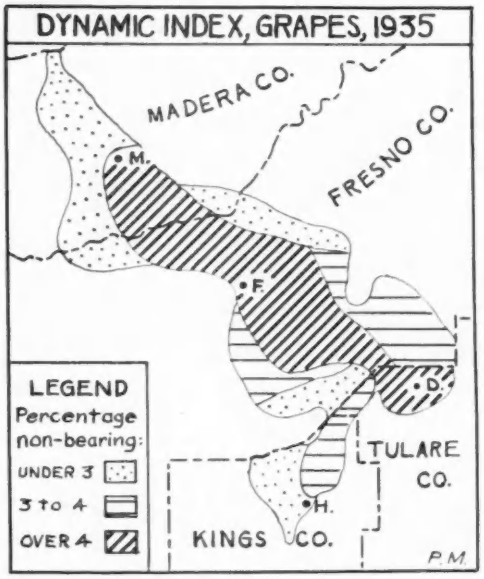

FIGURE 20.—Trends in the Fresno grape area in 1935, based upon statistics of bearing and non-bearing trees by minor civil divisions as reported by the Federal Farm Census. Evidently in this district the central core is still the most actively developing portion.

for most of these will not be maintained at its high 1936 level, a high rate of planting persists in the case of limes, suggesting that perhaps California may yet become an important factor in that crop. Aside from limes, nectarines, centering in the southern San Joaquin Valley, are the only other minor crop showing persistent current expansion. The three nut crops, pecan, chestnut, and filbert, showed a burst of new plantings between 1929 and 1935, as a result of which the dynamic index is still decidedly positive and bearing acreage may be expected to increase, especially for pecans and chestnuts. Current plantings are being made at a rate insufficient to maintain a positive index, however, and total acreage of each will probably decline from now on.

CONCLUSION

The total acreage and most types of California orchards and vineyards show a shrinking tendency, though a few crops, notably almonds, lemons, and raisin and table grapes, are expanding. A comparison of trends between and within districts shows that the already dominant centers are generally retaining their position of leadership, with fairly adequate proportions of non-bearing trees. It may be said, then, that on the whole a condition of adjusted localization prevails, with broad outlines of regional specialization pretty definitely established, though a few regional shifts are taking place.

Although exact acreage figures for 1940 are not yet available, scattered unofficial reports suggest that tendencies noted for 1939 have on the whole continued. Some statistical changes may result from the exceptionally heavy precipitation and floods of the winter of 1940–1941. In the great Sutter-Yuba peach district of the Sacramento Valley about 500 acres of cling peach trees are estimated to have been drowned by floods. Wetness of soil resulted in reduced volume of new plantings of almonds in the Butte County district of the Sacramento Valley. Profitable prices for olives for the first time in many years, due to the war-exclusion of oil from Italy, have not resulted in large new plantings, chiefly because of lack of nursery stock.

The prevalent tendency toward contraction of acreage is due primarily to general economic factors, not to any deficiency in the environment. The very productiveness of the California environments has led to expansion of plantings beyond the point where profitable markets can be assured.

LAND USE PATTERNS OF THE INNER BLUEGRASS

Leonard S. Wilson

THE Inner Bluegrass of Kentucky has long been accepted as an outstanding example of a geographic region in which the cultural and natural landscapes show strong relationships. All variations in the occupance seem to be related to the differences in the underlying rocks. However, to anyone who looks beneath the thin veneer of horse-farm occupance this explanation is insufficient. In order to understand the present-day use of land a consideration of past agricultural practices is necessary. The geologic region, it may be assumed, has remained static throughout the European period of settlement and has, therefore, presented to successive waves of immigration the same climate, physiography, soils, and vegetation.

Beginning in the later part of the 18th century, pioneers from Virginia poured into the Bluegrass. At various dates, depending on existing transportation facilities and the demand for various products in markets outside of the region, the settlement has emphasized, in succession, the export of horses and cattle, corn, tobacco, hemp, beef and pork, and finally tobacco, corn, and horses. At present the emphasis upon marketable products has become so great as to result in a particular pattern of settlement which has come about in part from the physical limitations of the region, but even more from the demands made by markets existing outside of the Bluegrass. Throughout the period of occupance there has evolved a mode of existence which has made its impression on the landscape in a pattern which reflects the characteristics of the agricultural economy. In response to various economic stimuli which have resulted from improved transportation facilities this mode of existence demonstrates the inhabitants' total comprehension of the environment in which they are working.

Physiography

The rock outcrops of the Inner Bluegrass are of Ordovician age, Lexington and Cynthiana series (Figure 1). These deposits are surrounded by the Eden

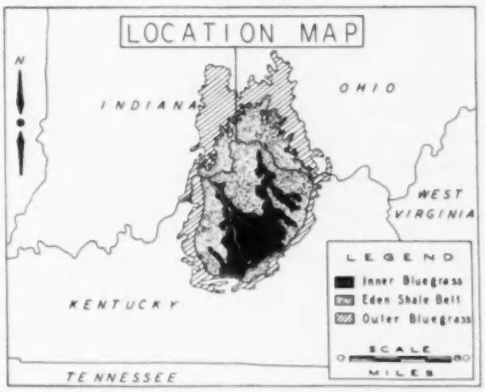

Figure 1.—The Bluegrass region of Indiana, Kentucky, and Ohio. The area under consideration is the Inner Bluegrass, the heart of the geologic region.

Shale Belt, a comparatively weak formation which weathers into an infertile group of soils, easily eroded and of inferior agricultural value. During the uplifting of the Cincinnati Anticline these sedimentary beds were warped into a dome which was reduced to the basin comprising the present-day Bluegrass Region. Greater strain in the center together with compression around the margins and a concentration of streams, resulted in a more rapid removal of material from the apex. Consequently, the more fertile deposits

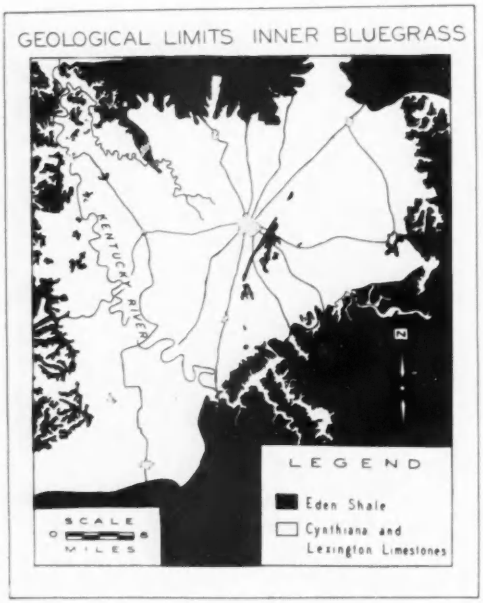

FIGURE 2.—Physical limits of the Inner Bluegrass. The illustration was compiled from various county maps prepared by the Kentucky Geological Survey. It was simplified to the extent of combining all outcrops of rocks older than Eden Shale to make the geologic region. While some other deposits are recognizable along the major stream valleys, they are of limited extent and have been classified with the major Cynthiana and Lexington limestone series.

underlying the Eden Shale have been exposed and make up the Inner Bluegrass (Figure 2). (No appreciable difference in the use of Lexington and Cynthiana Limestones could be observed. The surface configuration was so similar that they were classified together as Inner Bluegrass.)

SETTLEMENT

During earlier periods of settlement the Inner Bluegrass served as a magnet to attract pioneers across the unfriendly Appalachian Plateaus from Tidewater, Virginia, to the site of Lexington at the heart of the region. This city assumed leadership in the development of agriculture and early roads, such as the "Wilderness Trail" and the "Birmingham Trace," connected it with the eastern and southern markets. From the time of settlement until the opening of the Ohio Valley dependence upon land transportation confined exports to animals. Mules, horses, and cattle were the chief articles of trade and were exchanged for salt, gunpowder, textiles, and other manufactured items. Michaux, F. A., "Travels to the West of the Alleghany Mountains," D. N. Shury, London, 1805, pp. 178–193. According to Michaux cattle were driven in herds of 200 to 300 eastward to Philadelphia and Baltimore, while horses were driven in groups of 15 to 30 to the south. Some butter was exported to the Caribbean. (No attention was given to developing a superior breed of horse in Kentucky, at this time a cross between the Arab and Turkish stallions imported from the east, and the smaller Mexican horses, being most usual.)

Lack of communication with eastern markets during the frontier period and the era of river traffic resulted in the establishment of animal husbandry, while the few crops which could be shipped out had to bear a favorable relationship between bulk and value. Consequently, tobacco cultivation became important and much of the fertile land was either planted to this crop or allowed to remain in pasture.

Tobacco culture, because of high labor requirements per acre, led to the introduction of slaves on plantations of the region. (According to Hall, R. B., "Geography of Primary Production," 1932, the relative amount of hand labor for the chief crops of the Bluegrass are as follows: tobacco 375 hours, corn 19 hours.) Heavy yields, combined with extensive holdings brought about an agricultural economy consisting of tobacco, corn, and stock raising. This was extremely vulnerable to outside influences because of its predominantly marketable qualities. The Civil War

with its accompanying freedom for slaves and depression of agricultural prices caused a serious shortage of working capital. Agricultural products declined 75 per cent and landowners faced bankruptcy. (Figure based on a comparison of the U. S. Census for 1860 and 1870.) The combination of a lack of labor and capital together with the decline in market prices resulted in readjustment to existing economic conditions. Many of the larger farms were broken up; others passed into the hands of Northerners and a general reshuffling of ownership took place.

The new owners found themselves in conflict, not with the natural landscape but with the existing cultural impress. Former owners, impoverished by war, found that they necessarily had to realign their mode of living to conform with the changing order. New settlers brought financial backing and were accompanied by an expansion of railroads which tied the Bluegrass more closely to the industrial northeast. Former owners retreated to the maturely eroded lands bordering the Kentucky River or moved to the inferior Eden Shale Belt. In either case they reverted to marginal producers of commercial crops and subsistence farming.

BLUEGRASS PATTERN OF SETTLEMENT

The area under consideration, in contrast to the zone of Eden Shale, is essentially the location of extensive land holdings. These large farms may be

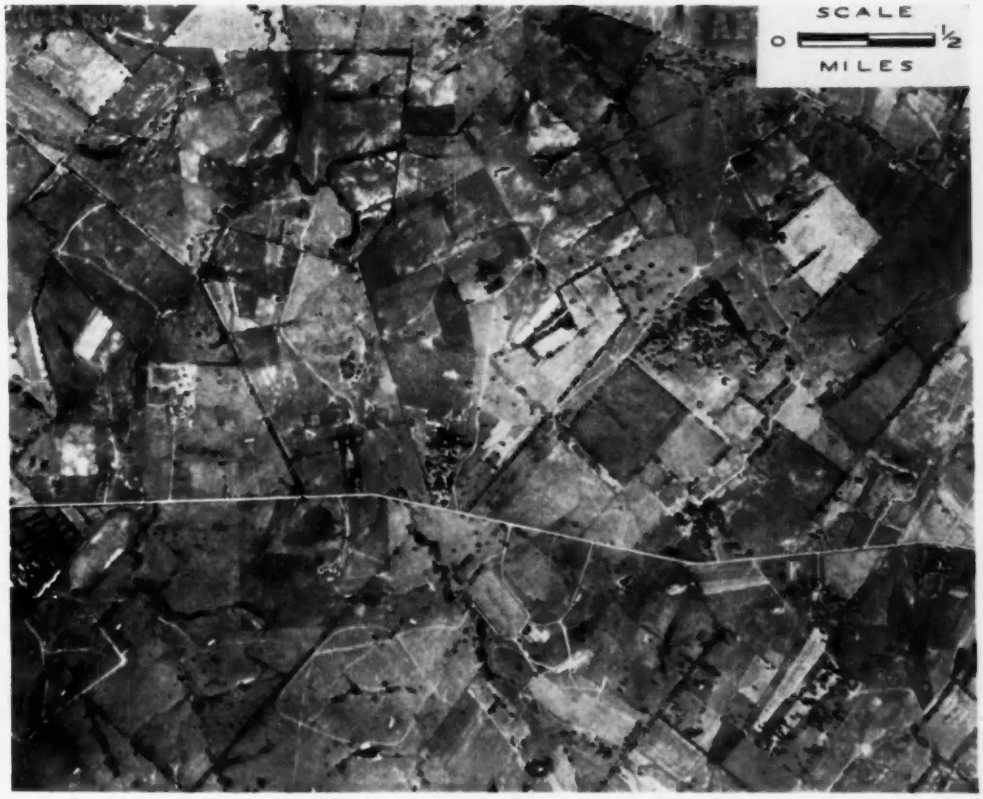

FIGURE 3.—Vertical air-photograph of a part of Fayette County, Kentucky, illustrating the stock-farm phase of the land use pattern. The extended field pattern, uniformity of texture and shade are representative of this type of settlement. (Courtesy of the Agricultural Adjustment Administration.)

divided into stock farms, many of which are owned by non-residents, or agricultural units in which only a small part of the total holding is planted each year (Figure 3). The pattern of field arrangement representative of the stock-farms is easily recognized. A uniform texture and shading together with extended field patterns cause these to stand out. The crop farms, while possessing the same patterns present a greater variety of shading and texture, indicating their dependence upon cropping; but excepting these differences they may be classified with the stock farms as composing the dominant Bluegrass pattern of settlement (Figure 4).

Regardless of the emphasis on stock or crops, both groups differ from other farms in that they are most dependent upon marketing the products of their fields. In no sense are they independent of trade for their livelihood. Little if any diversification of crops is practised; a rotation of tobacco, corn, and pasture- or orchard-grass is typical. Only a small part of the indivdual holding is ever devoted to plantings which are used directly by man. Normally over half of the farm is given over to the luxuriant permanent pasture which reflects the uniting of the fertile limestone deposits and a salubrious climate. (BB'r, Thornthwaite's classification.)

FIGURE 4.—Vertical air-photograph of a part of Fayette County, Kentucky, illustrating both phases of the Bluegrass pattern of land use. The greater variety of shade and texture in the eastern half of the picture is representative of the crop-raising phase. The western half shows part of Col. E. R. Bradley's "Idlehour Farm" with its race track, numerous small grazing plots, and extensive pastures with a park-like distribution of trees. (Courtesy of the Agricultural Adjustment Administration.)

DISTRIBUTION

The distribution of these farms shows the extent of the settlement pattern. In only a few isolated instances is there any degree of correspondence between the cultural and physical limits of the Inner Bluegrass. In the southern extremity of the region, along a major fault line, the limits of both coincide (Figure 5). The Bluegrass pattern here agrees with the geological limits, the southern portion being composed of Eden Shale with a semi-subsistence type of occupance.

Of more importance, since they are potential centers of trouble, are areas where such fortunate correspondence does not exist. One type is found in the numerous in-lyers such as one a few miles southeast of Lexington (Figures 6 and 7). While erosion is more noticeable there is no interruption in the field pattern, or crop association. More serious is the overrunning of the cultural landscape onto the surrounding Eden Shale Belt (Figure 8). Here, the lands formerly supported marginal producers but the encroachment of larger holdings is clearly indicated in this section. In some instances this has resulted in the retirement of inferior lands from crop production, but by far the greater number of consolidations have taken place for the further extension of commercial agriculture.

From a negative point of view areas

FIGURE 5.—Vertical air-photograph of a portion of Boyle County, Kentucky, near Junction City. The physical and cultural limits correspond. The northern part of the picture is Bluegrass while the more maturely eroded southern portion is Eden Shale Belt with small semi-subsistence farms. (Courtesy of the Agricultural Adjustment Administration.)

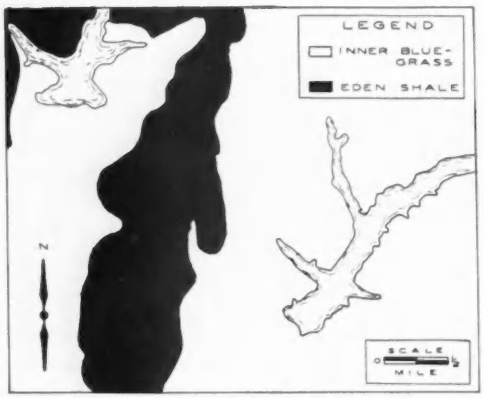

FIGURE 6.—Detail of the contact between the Inner Bluegrass and an in-lyer of Eden Shale in the vicinity of Lexington, Kentucky. The map covers the same area as that shown in Figure 7.

of Lexington and Cynthiana limestones which do not exhibit the Bluegrass settlement pattern may also be investigated. In every example these centers are related to areas of mature dissection or are poorly served by modern transportation lines. Where nearly vertical walls of the deeply intrenched streams have broken down, the settlement pattern resembles that of the Eden Shale Belt. In others which do not present a mature surface, the morphology of Bluegrass settlement persists to the walls of the valley (Figure 9). The maturely dissected lands have surfaces similar to the Eden Shale Belt, and comparable reductions in crops are evident.

Although no statistics are available a large number of new pioneer dwellings are being constructed. Many of these are owned by families from the sur-

FIGURE 7.—Vertical air-photograph of a part of Fayette County, Kentucky, in the vicinity of Lexington. The Bluegrass pattern is well developed on Eden Shale. The area covered is identical with that shown in Figure 6. (Courtesy of the Agricultural Adjustment Administration.)

rounding uplands, replaced because of the decline in crop values. In this respect the situation is akin to that at the close of the Civil War. It is markedly different in that the 1860–70 decade showed a total increase in the value of farm land of 1.3 per cent while the 1925–35 period shows a decline in value of 26 per cent. (Figures quoted are based on the U. S. Census for 1860 and 1870 and the Census of Agriculture for 1925 and 1935.) Forced, through the loss of income, with mortgage values depressed, the lands formerly occupied by these families have passed to owners from other parts of the country and have been withdrawn from crop production. This necessarily means a reduction in planting in the Inner Bluegrass. The concentration of these new small holdings along the main streams interrupts the radial pattern of settlement which was established along the main roads leading to the urban centers (Figure 10).

The distribution of Bluegrass settlement indicates that factors other than the underlying fertility of soils have important bearing on the subject (Figure 11). Constricted in the south and southwest it does not approach the limits of the geological region. In the north and east it extends beyond the limit of deposits, while a broad zone of smaller farms transects the area in the vicinity of the Kentucky River. To the west the pattern is limited and

FIGURE 8.—Vertical air-photograph of a portion of Scott County, Kentucky, near the town of Stamping Ground. The more maturely eroded surface and small farms characteristic of the Eden Shale belt is shown. Near the center of the picture extensive landholdings may be seen encroaching on the small farm pattern. (Courtesy of the Agricultural Adjustment Administration.)

broadens only in the vicinity of Danville.

COMMUNICATIONS AND BARRIERS

The radial road pattern focusing on Lexington, and to a lesser extent on the smaller agglomerations, reflects the commercial characteristics of the Bluegrass pattern of settlement and emphasizes the importance of intra-regional and inter-regional trade. Where barriers to the free flow of traffic exist, the pattern has not been well developed. One such major obstacle is the Kentucky River, which cuts off the western Bluegrass from Lexington and the tobacco markets. At present the only means of crossing the river is by a public toll bridge or privately owned ferries. Toll rates for the bridge are sufficient to form an obstacle to motor traffic, while use of the less expensive ferries is discouraged by a failure of the road commissions to keep roads leading to the private ferries in good repair.

In the north and northeast, closest to the major urban centers of the region and the country, occupance has spread beyond the physical limits. Here, despite the roughness of the surface a more complete highway system has been built. No large streams, requiring complicated bridges, bar the free flow of traffic within the Bluegrass, while highways to the east are more numerous and lead to more important markets.

FIGURE 9.—Vertical air-photograph of a part of Boyle and Garrard counties in the vicinity of Dix Dam. The land use pattern characteristic of the farming phase of Bluegrass settlement is here shown extending to the margins of the deeply entrenched river. (Courtesy of the Agricultural Adjustment Administration.)

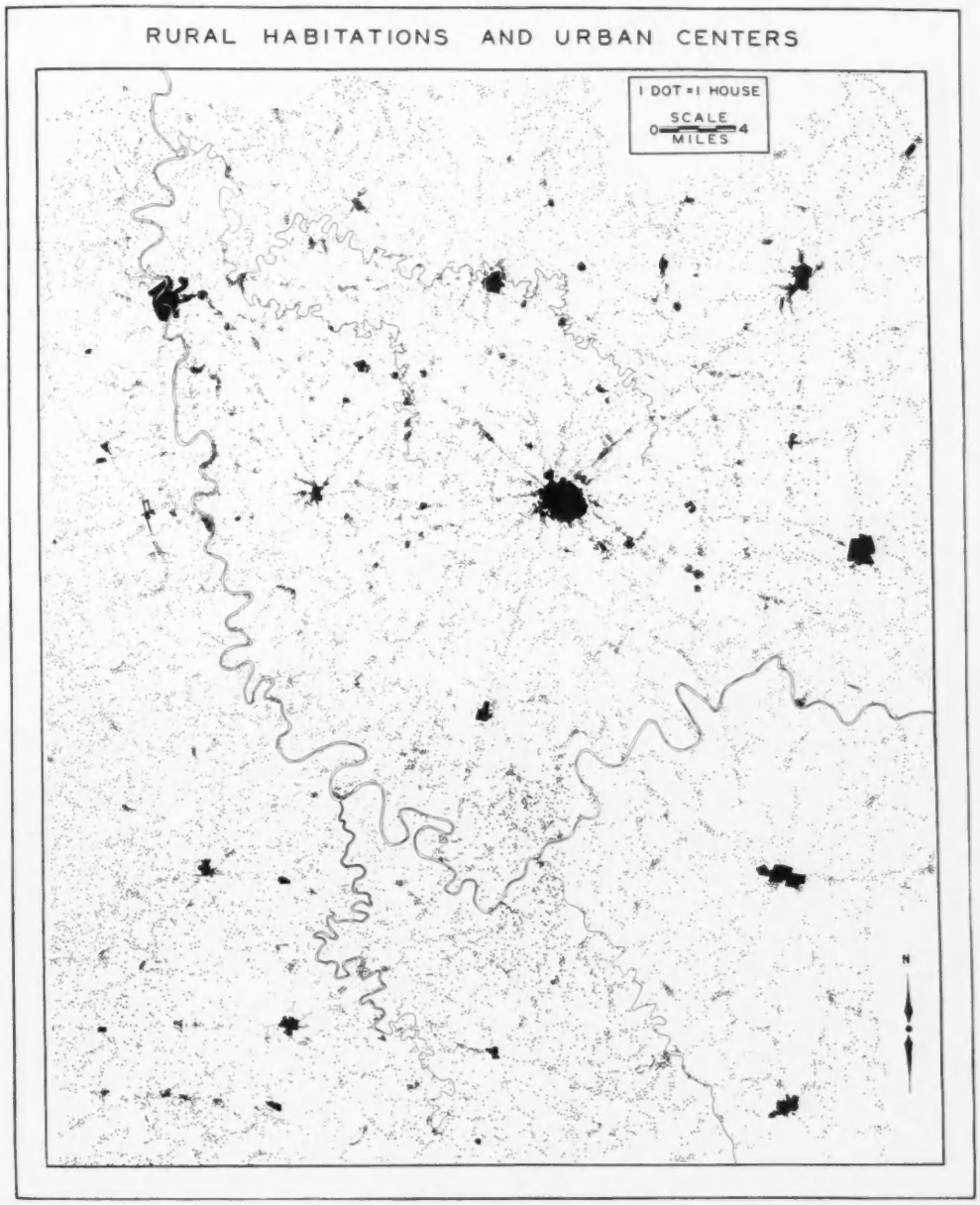

FIGURE 10.—Distribution of rural habitations and urban centers. Based on the topographic maps of the U.S.G.S. Scale 1/62,500. The maps were further checked and revised in the field during the summer of 1939.

CONCLUSION

The imposition of the cultural and physical limits of the Inner Bluegrass indicate that there is no strong relationship existing between the environment, in which the inhabitants find themselves, and the pattern of settlement which they have evolved (Figure 12). Only along one boundary is there any strong coincidence between land and occupance.

The pattern of settlement developed

FIGURE 11.—Limits of the Bluegrass pattern of land use. The map is compiled from air-photographs in the Lexington office of the Agricultural Adjustment Administration. The original scale of the photographs is 1/20,000.

through the years, not as a result of the underlying qualities of the region, but because of lack of access to markets during the pioneer period. A magnification of this pioneer type of settlement to a mature commercial farming economy, based on the availability of cheap labor, followed. With the abolition of slavery and the resulting disruption of agriculture, a temporary decline in farming set in. This continued until the introduction of new capital and new routes of market were supplied by interests originating outside of the Bluegrass Region.

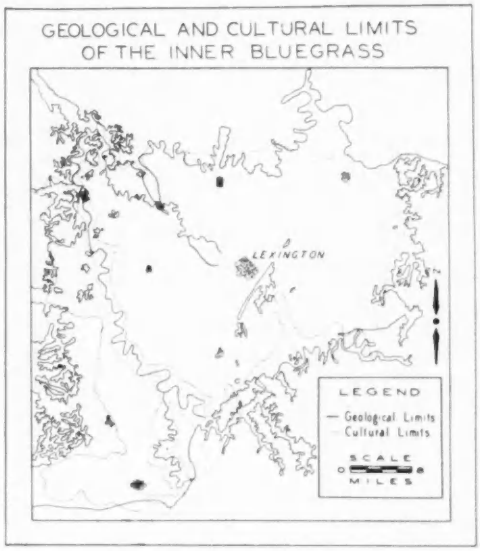

FIGURE 12.—Physical and cultural limits of the Bluegrass superimposed. Areas which show the greatest amount of overlapping of the cultural limits are concentrated in the northeast. Each of these is a future possible problem center.

At present the lack of relationship between Nature and Man is strongest where the access to outside markets is most highly developed. The Bluegrass pattern of settlement is the result of commercial stock and crop farming rather than a result of the underlying qualities of the land.

INDUSTRIAL GEOGRAPHY OF LOWER WABASH VALLEY

Alden D. Cutshall

FROM earliest times the Wabash River was a route between the north and south. At the fording places it was crossed by ancient paths worn by both animals and aborigines in their migrations between east and west. Near this picturesque stream, mound-builders left vestiges of a remote past and a forgotten race. Indian tribes dwelt along its banks and travelled both land and water routes. In turn, French explorers and missionaries followed. Early in the eighteenth century Vincennes was established, becoming the first settlement in this region and later the capital of Indiana Territory.

From France, England won the region in the French and Indian War (1763). During the Revolutionary War the British commander came down the Wabash, making Fort Sackville (Vincennes) the key to the frontier. George Rogers Clark and his troops followed the buffalo trace from Kaskaskia toward Vincennes and captured Fort Sackville from the British in 1778. Later, pioneers came, seeking new homes in Indiana, Illinois, or beyond the Mississippi. The youthful Abraham Lincoln, making his last pioneer move, crossed the Wabash River on the way from his father's cabin in the Indiana hills to his new home on the Illinois prairies.

The lower Wabash Valley (Figure 1) possesses a wide variety of physical endowments, although not all of the available natural resources are first quality materials. The climate is certainly favorable; the soil is of better than average fertility over much of the region, and areas of rugged terrain are restricted to strips along the upland border; abundant mineral fuels are available over a wide area, although quality of the coal is not of first rank; the same is partially true of clay deposits, limestone formations, and sand and gravel beds; permanent surface and ground water supplies are easily obtained along the principal streams, but more difficult to obtain on the upland till plain. Hence, the physical endowments of the area are characterized, in general, by diversity rather than uniformity, by availability rather than inaccessibility, and by average rather than superior quality.

The region is an area of gently rolling terrain that invited an agricultural population which, even in the period of appropriation, was dispersed over the entire valley. The economy of this period was characterized by primitive agriculture, producing a small agricultural surplus that led to a limited commerce but not to manufacturing, except for the domestic industries which were characteristic of a frontier community.

During this period manufacturing was limited to those phases which were closely associated with agriculture. It was not until the railroad period with its accelerated growth in population and vastly increased accessibility that the industrial forces functioned to initiate the present manufacturing activity. Proximity of coal and other mineral deposits only added to the growing industrial development which continued without interruption from the end of the Civil War to the post World War era.

Thus, the landscapes of the lower Wabash Valley are a set of cultural

FIGURE 1.—The shaded portion of Illinois and Indiana represents the area studied. It is not a region that is limited by natural boundaries, but is an area which is commercially tributary to the Wabash cities and has an economy which is directly related to the immediate natural resources.

impressions set one upon the other. Three cultures: native Indian, rural agricultural, and urban manufacturing, have each modified the natural setting in a characteristic way. Urban landscape, in spite of its relatively small area, has come to occupy a position of commanding importance around which the economic structure of the region is organized. But change still continues. Less favorably located urban communities have reached a zenith of growth and prosperity and are now shrinking in size and relative importance. Yet population continues to increase in other cities where production is maintained by more intense and efficient activity. It seems probable that this present tendency will continue for some time, and as it does, so importance of the paved highway must increase, inasmuch as the railway service for smaller communities has been definitely dwindling for more than a decade.

POSITION OF INDUSTRY

The Wabash Valley is not an independent, unique region; it is essentially an area which is illustrative of the nature of manufacturing in large parts of the country. Its boundaries or size are not critical factors, but qualities of the area within it are of geographic and economic significance. It can hardly be called a sample area, as that term implies homogeneity. Rather it is a specimen which has been taken from a broader area to be analyzed as a type or as an example.

This article is not easily correlated with previous studies in industrial geography. Wright's article on the Middle Miami Valley (Alfred J. Wright, "Industrial Geography of the Middle Miami Valley," *Michigan Academy of Science, Arts, and Letters*, Vol. 21, 1935, pp. 401–428) is the only comparable regional study in the United States, and his area is characterized by highly skilled workers and high value added by the manufacturing process. These qualities of industry are lacking in the Wabash area which is characterized by semiskilled workers and relatively low wage payments, high cost of raw materials per worker, and lack of a precision quality to the industry. Colby's analysis of centrifugal and centripetal forces in urban geography (C. C. Colby, "Centripetal and Centrifugal Forces in Urban Geography," *Annals of the Association of American Geographers*, Vol. 23, 1933, pp. 1–20) can be applied to the Wabash Valley but will generally result in negations. There are no pronounced uprooting forces emanating from the larger cities of the region, and, with the exception of the shoe factories, no important industries are the result of dispersion from larger midwestern cities. Economic results of accessibility which are reflected in virtual cessation of local

service by railroads and closing of mills and creameries of smaller cities and villages have tended to localize manufacturing at more favorable centers, yet any individual city may offer little if any geographic advantage over that of its neighbor.

The region as a unit does possess certain attracting forces. There is a functional convenience which is manifested to the greatest extent in the agricultural and mineral attachments. Available labor and the nature of transportation facilities also serve to attract industry. This regional convenience is expressed by the establishment of branch plants of national concerns: International and Brown Shoe Companies, American Can Company, Bell Bakeries, Kraft Cheese Company, Fort Wayne Corrugated Paper Company and Central Fibres Products, National Fireproofing Company and American Vitrified Products, to name a few of the more important ones.

The essential character of the modern industrial organism of the Valley is based upon certain factors, namely: (1) uniformly dense agricultural population in the area; (2) localization of the major urban centers at railroad junctions, which in some cases were important river cities prior to the railroad era; (3) availability of an adequate supply of cheap fuel; (4) mechanization of farm work which served as an attracting force for manufacturing industries because of the surplus labor which became available.

EARLY MANUFACTURING

Prior to the Civil War manufacturing in the Wabash Valley progressed through two stages of development. In the days of early settlement home or household industries predominated, as was the case in all newly settled areas of the period. As the region developed and population increased a considerable number of factories were established, but these attempts were characterized by uncertainty and experiment. Some industries prospered and their importance increased through the years, while others were short-lived, being unable to survive after the pioneer period of self-dependency had passed because they could not successfully compete with establishments located in more favorable sections. A third group included those industries that were somewhat intermediate in character; they enjoyed success for a limited time, yet they did not prosper and increase.

FIGURE 2.—A branch of the American Can Company was located in the Wabash Valley at the request of its numerous customers in that region. (Courtesy of Terre Haute Chamber of Commerce and the American Can Company.)

Between 1840 and 1860 there was a marked decline of household industries and a similar increase in factory methods. Early manufacturing was normally the outgrowth of some local establishment, as the manufacture of agricultural implements and carriages tended to develop from blacksmith shops. Other industries owed their development to the fact that they supplied a basic need of the region or a necessary raw material of some major type of manufacturing. The salt works of Shawneetown and other saline deposits can be classed in this group, for they supplied pork packers with a very necessary raw material. Importance of the local flour and lumber mill grew rapidly after about 1830 or 1840, for grains and

timber were the most important raw materials. Whiskey, too, was made everywhere, as commonly as grain was ground, and the farmer paid in kind to have his corn converted into distilled liquor in the same manner that he paid the miller for grinding his grain. Other early manufacturing included the ice industry which developed at Terre Haute along with the packing industry, furniture and cabinet making, a few early iron furnaces, and a limited amount of textile manufacturing, the latter largely experimental in character.

INDUSTRIAL CHANGE, 1860–1940

The general period between the Civil War and the present has been characterized by a maturing of the region. The maximum recorded population of the Valley was attained by 1910 and cities and towns occupied an increasingly important position as manufacturing became established on an equal basis with other industries. Transportation lines were connected and consolidated, new industrial plants being localized along or near railroads. This has been a long period of industrial selection with the only significant break coming about 1920 as the result of the changing social trend of the nation.

FIGURE 3.—The large plant of the Commercial Solvents Corporation is located on a broad curve of the river. The plant was a pre-Prohibition distillery which was used by the United States and British governments to make acetone during the World War. It was purchased by the young Commercial Solvents Corporation in 1919 and now manufactures a variety of solvents and related compounds as well as distilled liquors. The latter are sold in the wholesale market as the company has never entered the retail field for this product.

After 1860 manufacturing industries gradually became more and more independent of the home and the immediate countryside, but for many years they remained identified with the particular needs of the growing communities and, in general, were still dependent upon surplus production of the area, especially grain and livestock. As the center of population advanced westward, manufacturing tended to follow, and a wider variety of industries was the result. (The center of population advanced from West Virginia to Bloomington, Indiana, between 1850 and 1920 and as far as Linton, Indiana, by 1930. During this period the center of manufacturing shifted from central Pennsylvania to western Ohio.) As the railroad system became more compact, a greater number of industries were attracted and the inter-regional trade became progressively more important. Other manufactures were a response to local needs, the products of which were too bulky or too heavy to stand transportation from the industrial centers located some distance away. Whereas a half century ago the manufacture of essential materials was paramount, a growing share of the manufactures now consists of unessentials.

The increase in value of manufacturing and in the number of persons employed in manufacturing pursuits has been much more rapid than growth in population. During this eighty-year interval the number of establishments has diminished, but there has been a vast expansion in their aggregate output. This industrial expansion was a result of the wider use of power and machinery both accompanying and fol-

lowing the decline of household manufactures.

Even more noticeable than size of individual industries has been the change in type of manufacturing which has characterized industrial growth in the region. Grain mills, saw mills and other pioneer service industries still supply neighborhood customers, but have steadily lost ground to establishments serving national markets. The shop making boots and shoes is no longer in existence, but the modern shoe factory makes footwear of greater variety and more uniform quality. Agricultural implements are now made in a few large urban centers some distance removed from the Valley, and the local iron and steel industry is being supplanted by secondary metal manufacturing (Figure 2) and the fabrication of specialized machinery and electrical equipment. Brickyards were once rather evenly distributed throughout the region, but are now localized in the section having both coal and clay in close proximity and suitable market facilities. Retrogression of furniture and other wood products industries has coincided with decrease in timber supply, and meat packing has declined in favor of the metropolitan packer. Distilling and brewing industries passed completely from the scene from 1919 to 1933 but have returned since the later date (Figure 3). Canning factories, strawboard paper plants (Figure 4), and clothing manufacture have increased consistently for the last fifty years. Tobacco, once a promising industry, has become negligible, but the making of brooms, another old industry, has held its own despite decline in the number of factories. A variety of new establishments manufacturing bottled beverages, sporting goods, radio and television parts, photo supplies, advertising novelties, cosmetics, glass mirrors and trinkets, thermostats, and similar articles indicate the trend from making of necessary commodities to manufacture of non-essentials.

FIGURE 4.—The south plant of the Terre Haute Paper Company is located along the river at the southwestern corner of the city and is one of the newer industrial establishments.

INTRA-REGIONAL VERSUS INTER-REGIONAL DEMANDS FOR RAW MATERIALS

Local raw materials are becoming relatively less important to the Valley's industries than has been the case in the past, but most of the major firms remain closely associated with the abundant local resources. Ample coal and water are available and both petroleum and natural gas are obtained from local wells. Proximity of excellent deposits of clay and sand offer unusual advantages for construction industries. Timber resources have ceased to be of major significance, but local grain supplies mills and distilleries, and the straw moves to plants making corrugated paper and associated products. The Valley's fruit and vegetable areas supply smaller canning and preserving factories and the local animal industry keeps packing houses in operation.

The variety of raw materials coming from more distant areas is increasing rapidly. Pig iron and steel ingots are shipped from Chicago furnaces, and other metals are also received from outside the Valley. Silica sand for the glass industry and chemicals for paint

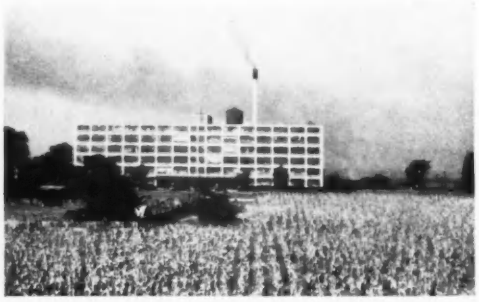

FIGURE 5.—The Quaker Maid plant, a subsidiary of the Atlantic and Pacific Tea Company, is located on the eastern outskirts of Terre Haute and is the largest employer in the lower Wabash Valley. Products include jams, jellies, noodles, beans, peanut butter, and other trade products and are shipped to the company's warehouses from Dallas and Kansas City to Buffalo and from Cleveland and Chicago to Atlanta.

manufacturers are shipped from various sources, and clays from Kentucky and Tennessee are used in making sanitary ware. Shoe leather comes from St. Louis or one of the major tanning centers and many textiles used in the garment industry are the product of cheap southern labor. The large Quaker Maid plant (Figure 5) uses California fruits and vegetables which arrive in the frozen state to be made into preserves and jellies before continuing to eastern and midwestern warehouses. Better grades of coking coal are supplied by the Appalachian field. Caustic soda and soda ash for paper and glass industries are shipped from Chicago, and centers in Michigan and Ohio. Scrap paper and old magazines come from all directions, company-owned trucks of paper mills usually bringing a return load after making delivery of their trade products.

Numerous supplies originate outside of continental United States, coffee and spices obviously falling into this classification. European ball clays are used in Robinson, and carbon comes to Lawrenceville from Europe. Tropical hardwoods are made into radio cabinets and furniture at Bloomfield. Cassava starch, rice starch, and various waxes and gums are used in Terre Haute and Brazil, while the few remaining cigar manufacturers use both domestic and imported tobaccos.

LOCALIZATION OF INDUSTRY

Industrial plants are localized along railroads and, in Terre Haute and Vincennes, along the banks of the Wabash (Figures 6, 7, and 8). Many riverine locations date from the period of river transportation, but in Terre Haute the manufacturing district in the southwestern part of the city has expanded considerably since that date. It has come to contain many of the city's bulky manufacturing plants which, in some cases, are the more odoriferous and unsightly establishments. Locations along the railroads can be attributed to growth of industry during the period that the railroad provided the only successful means of transportation. Secondly, despite the fact that large quantities of products are moved by motor truck, the railroad remains as the major form of transportation for raw materials if not for manufactured articles.

Probably the amount of industry that is located outside the political city is somewhat unique. This is especially true at Terre Haute where the corporation limits appear to skirt the industrial establishments in such a manner as to place them outside the political boundary (Figure 6). It is to be expected that the clay plants of Brazil will not be found within the city, and plants manufacturing explosives are restricted from urban locations. But the largest manufacturer at Paris, the two major ones at Robinson, the refinery at Lawrenceville, two of Vincennes' major industrial plants, and Snap-On-Tools of Mt. Carmel are just beyond the political city. At Terre Haute it is

not unusual that the large hothouses are outside the city, but Winslow scales are made a mile north of the corporation limit while Highland Iron and Steel, Quaker Maid, Indiana Wood Preserving Company, and one of the two plants of the Terre Haute Paper Company and Commercial Solvents Corporation are also outside the corporation limits. Probably one-half of the industrial employees of Terre Haute, about one-fourth of those of Vincennes and Paris, and over three-fourths of those of Lawrenceville, Robinson, and Brazil are employed in plants outside the limits of the political city.

THE AREA AS A TYPE

The lower Wabash Valley has few, if any, features of industrial uniqueness;

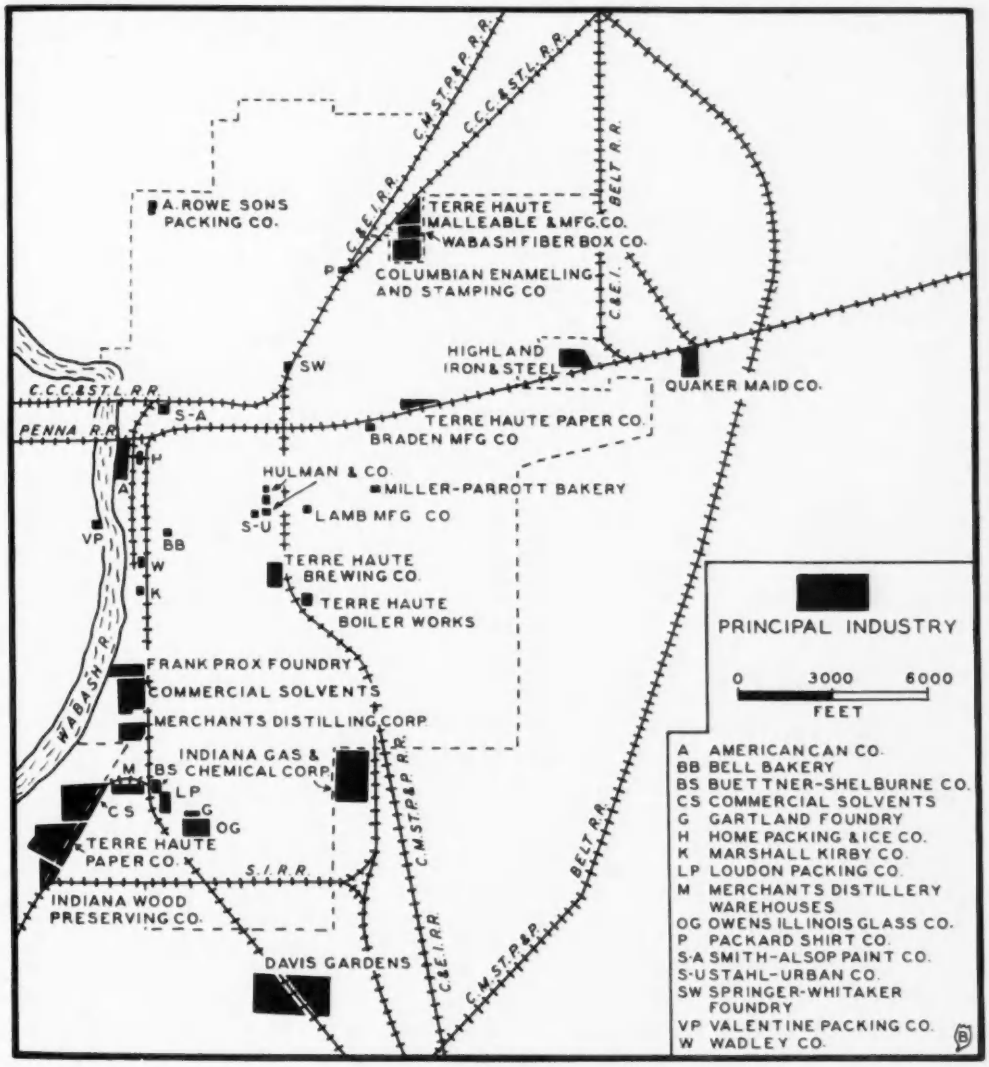

FIGURE 6.—Principal industries of Terre Haute are along the river front and the railways, but many of the major establishments are outside the limits of the political city. The city's industrial organism is not characterized by a dominant type of manufacturing, but rather by a number of small thriving factories which more or less dovetail into each other, thereby giving a more balanced economy and tending to stabilize the economic life of the city.

rather, it is an area that is representative of a great portion of that part of the United States lying between the Appalachian Highlands and the Mississippi River. The life of the people is not dependent upon manufacturing, or upon mining, or agriculture, but upon a combination of these basic industries. The manufacturing of the area is not limited to a few large concerns; there are no true "one-industry" towns. The Valley manufactures a variety of products in a number of relatively small industrial plants. (Of the sixteen industries and industry groups mentioned in the Census Report of 1930 only one, rubber, is not to be found in the lower Wabash Valley.) Terre Haute, the largest urban center, has no dominant type of manufacturing; it is, in a measure, a self-contained city with one industry more or less dovetailing into another. The number of small thriving manufacturing plants is probably unusual, but it gives a more balanced economy and tends to stabilize the economic life of the city.

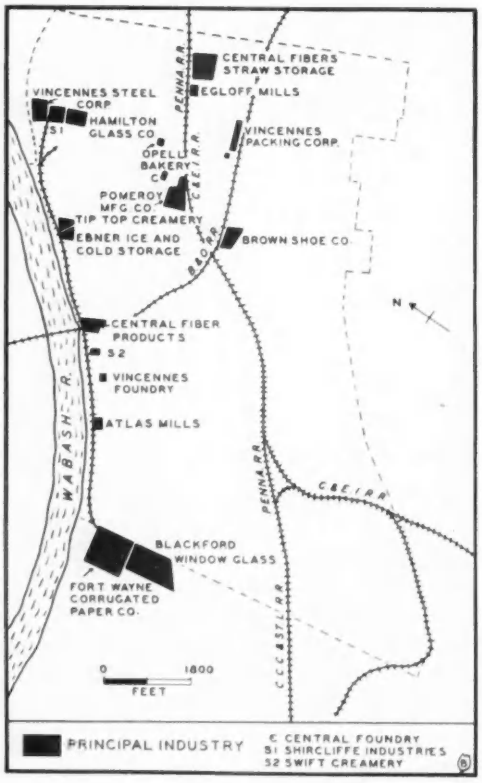

FIGURE 7.—Most of the industries of Vincennes are localized in the northern part of the city. The majority of these plants have been in operation since about the turn of the century.

If industrial diversification be considered the normal form of economic structure for a fully matured area, the Wabash area can be considered as a mature economic region. It has passed through a long period of industrial selection and has experienced neither very rapid nor very slow growth. This, too, is considered characteristic of an area with a large number of more or less equally important industries; whereas an area dependent upon one industry may have rapid growth or it may progress very slowly.

A high percentage of manufactured goods produced in the lower Wabash Valley is destined for human consumption. Bliss (Charles A. Bliss, "The Structure of Manufacturing Production," p. 125) in analyzing the nation's manufacturing, lists the four major divisions of consumption goods in order of their magnitude (according to value added by manufacture) as: (1) wearing apparel and personal equipment; (2) foods; (3) household goods, and (4) motor vehicles. The first two listed are dominant groups in the Valley; manufacture of household goods is of secondary importance, while fabrication of motor vehicles is now completely absent from the local economy.

Most manufacturing is done in plants whose products can be classed as "finished," that is, the products are sold for purposes other than further manufacture. This is especially true in the foods industry, including beverages and liquors, and in the wearing apparel and personal equipment group. The extent of intermediary fabrication (pro-

duction of unfinished goods in relation to production of finished goods) is greatest in the foundries and other metal processing plants and paper manufacture. In brief, this relationship is less evident in the manufacture of consumer's goods than in producer's goods manufacture.

A large percentage of the Valley's manufacturing involves the processing of local materials, of which agricultural commodities are of foremost importance. (In 1934 Garretson found that one-third of the firms in Terre Haute used local raw materials, whereas, two-thirds were at least partially dependent upon widely

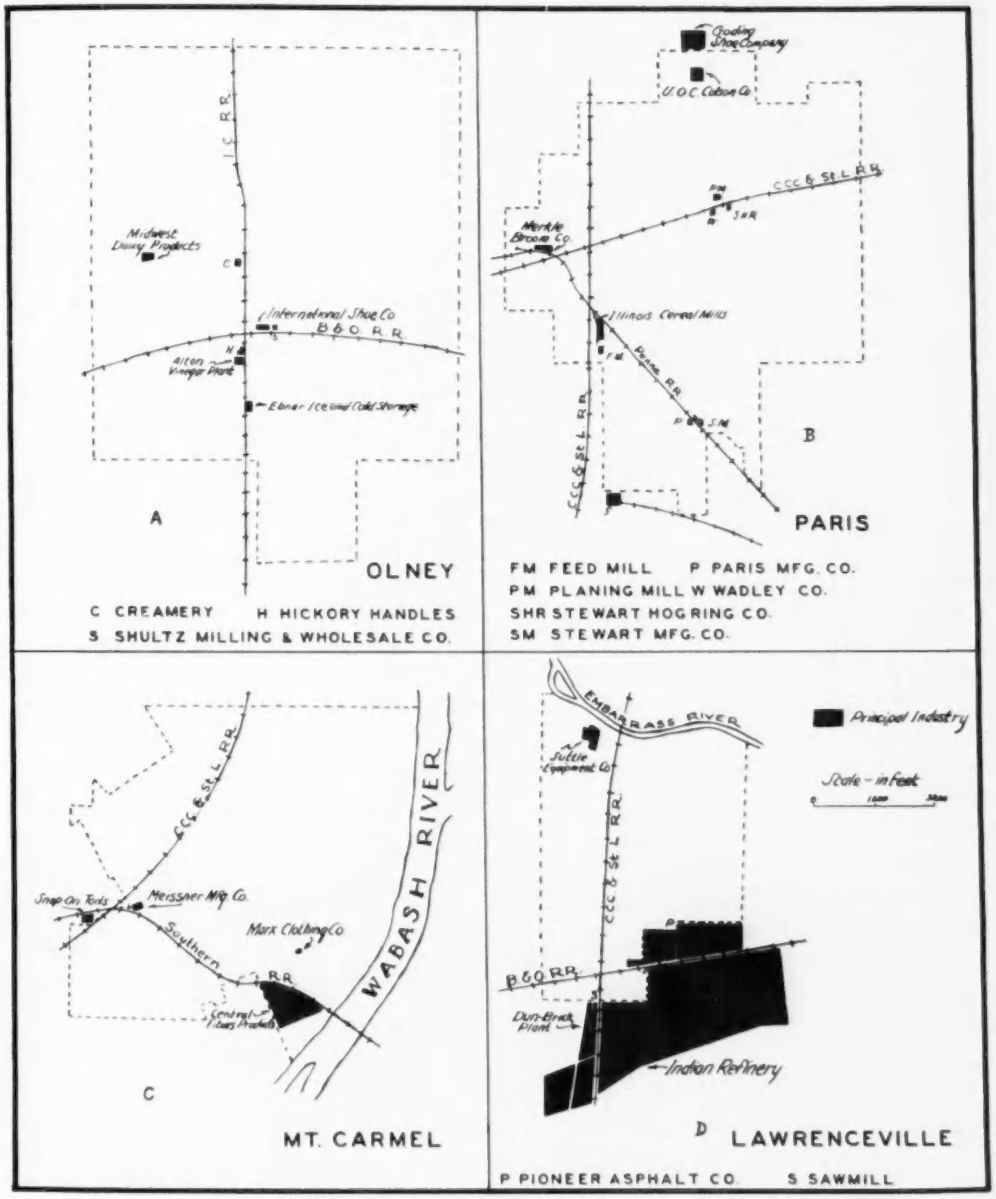

FIGURE 8.—Industries of four Illinois cities in the lower Wabash Valley.

distributed areas for their materials [W. C. Garretson, Personal Traits, Knowledge, and Skills Considered in Reference to Employment in Terre Haute Industries, p. 3, unpublished Master's Thesis, Indiana State Teachers College, Terre Haute, Indiana, 1934].) In this respect the Valley's industrial activity differs considerably from that of the nation. In 1929 the nation's most important materials were metals (38 per cent of the total value added) whereas fabrication of farm and animal products was only slightly more than one-fourth the total. This difference can be explained, at least partially, by the fact that value of farm products, due to processing, is doubled, whereas, value of minerals, due to fabrication, increases several fold. (Bliss, *op. cit.*, pp. 126–127.)

A low percentage of the nation's total wage earners is employed in making consumption goods; yet in the Wabash Valley the great majority of workers are employed in consumption goods industries. This fact tends to exemplify the local importance of consumer's goods manufacture; however, one factor slightly modifies this hasty conclusion. In manufacture of wearing apparel, of which shoes and work garments are of local importance, relative labor requirement increases, exceeding that for capital goods in some cases.

Surveying the area as a unit, lack of a dominant industry or group of related industries is very much in evidence. Mills remain in many localities; meat packing and the processing of other food products are widely distributed; shoes or articles of clothing are manufactured in a majority of the counties; a large number and variety of ceramic plants are located in the northern portion of the region; steel and other metal products are manufactured over an area extending from Mt. Carmel and Princeton to Terre Haute and Paris; and strawboard products are made in five river cities from Terre Haute to the Ohio River. This wide distribution, together with refineries of the Illinois cities, distilleries and brewery of Terre Haute, numerous plants using wood or lumber as a raw material, various community industries that obviously are scattered throughout the Valley, and a variety of miscellaneous manufactures tend to exemplify lack of any industrial concentration and domination and to illustrate the prevalence of dispersed and diversified industrial activity.

In only a few cases (shoe and garment factories, for example) do individual establishments confine their manufacturing activities to a single item. Many of the clay plants make a variety of products and some of the strawpaper plants fabricate several types of containers and packages, shifting their personnel inter-departmentally from week to week or season to season. The manufacturers of art goods and novelties have added supplementary items to balance their employment during the slack season, and some of the major food and dairy products concerns have similarly added suppletory lines. J. H. Heath and Company of Robinson started as a small town dairy and ice cream plant, then a creamery was added, later a bottling plant was established, and finally a candy factory constructed. These four items, all related to the original line, are now manufactured in the same physical plant. As a result the number of employees is fairly constant throughout the year despite the fact that each of the products must supply a market that is more or less seasonal in character.

As has been previously stated, the lower Wabash Valley is an area of small industries. There are only six establishments having an average employ-

ment exceeding 500, and thirteen concerns comprise a group employing between 250 and 500 persons. Consequently, about two-fifths of the industrial workers are associated with plants employing less than 250 wage earners and salaried officials. Further breaking down this classification the writer estimates that about 20 per cent of the industrial workers are employed by firms having less than 100 workers, 20 per cent in firms having 100 to 250 employees, about 30 per cent in plants of 250 to 500, and about 30 per cent in plants of over 500 employees.

Importance of the small plant is evidenced by the fact that over one-fifth of the workers are employed in establishments of less than 100 employees. Terre Haute probably has 60 to 70 industries that employ from six to twelve people each. Wabash County had 757 industrial workers in 1937 (Figure 9), yet the writer is reasonably certain that approximately two-thirds of that number were employed in plants with less than 100 workers. Clay County with its numerous ceramic establishments probably has no one plant with more than 100 employees. During the summer of 1939 a list of over 50 Vincennes industries and wholesalers was prepared. This list included two major factories employing approximately 500 and 300 respectively; five plants of approximately 100 (75–150) employees; six firms of approximately 50 (35–74) workers; eight establishments of about 25 (15–43) employees, and thirty-two firms with less than fifteen persons on the pay roll. These examples are illustrative of the characteristic importance of small establishments, and in only a few communities is there an absence of varied manufactures.

To summarize, the industrial development reflects (1) presence of natural resources and agricultural products that require but little processing and relatively little industrial labor, hence a high value of the manufactured product per wage earner employed; (2) importance of transportation as a locational factor; (3) a dynamic industrial structure composed of numerous, small, diversified manufacturing establishments located in or near the principal cities which are also the county-seat towns; (4) growth of urban service industries, but generally not beyond consuming capacity of the local market, and (5) a widely ramified market for manufactured goods, limited somewhat by absence of a nearby metropolitan outlet.

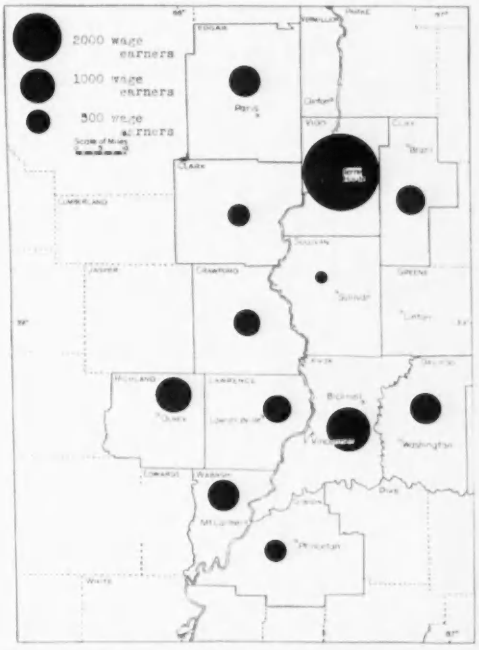

FIGURE 9.—More than one-half the industrial wage earners of the lower Wabash Valley are associated with the plants at Terre Haute and Vincennes, but manufacturing is reasonably important in at least seven of the ten remaining counties that were studied.

URBAN GROWTH IN THE SAN DIEGO REGION

Nicholas Mirkowich

THE main characteristic of urban development of the last decade in the United States has been a consistent and steady movement toward stabilization and stagnation. The limit of the growing period of American cities has undoubtedly been the Great Depression of 1929–1934. This does not mean that cities will stop growing, but rather that the growth will take a slow course. We can still expect that hundreds of thousands of people will be added to our large cities, but on the other side we are more or less sure that the American city, the major part of the large ones at least, has reached a stage of demographic stagnation. This is not only a guess as to the future but a conclusion based on returns of the 1940 census made available through preliminary tabulations by the United States Bureau of the Census. Populations of San Francisco, Philadelphia, St. Louis, Boston, Cleveland, Newark, and Rochester have declined in the period 1930–1940. Populations of Chicago, Detroit, Pittsburgh, Milwaukee, Buffalo, Cincinnati, Kansas City, Seattle, and Louisville are stagnant, relative increases being insignificant. Population of a limited number of cities only—Washington, Los Angeles, Denver, Baltimore, Houston, and New Orleans among them—have increased considerably, but at a much smaller rate than in previous decades.

Two regions seem to make exceptions of the general trend toward stagnation and decline of urban areas: Southern California and Texas. The rapid growth of Southern California and Texas cities has not been stopped in the decade 1930–1940. The same is true, with some modifications, for some other southwestern regions: in the first place the Maricopa irrigated area of Arizona with the heavy urban concentration in Phoenix, and the Oklahoma and Tulsa counties in Oklahoma. Oklahoma City has shown an extremely high rate of population increase ever since opening of the former Indian Territory for homesteading, but growth in the decade 1930–1940 has been counteracted by heavy exodus of urban population to Arizona and California. Oklahoma County, urban and rural as well, shares with Tulsa, Caddo, and Muskogee counties first place in the source of population migrating to the Pacific Coast.

Very characteristic of the urbanization trend in the American Southwest is the growth of population in the San Diego Metropolitan Area in Southern California. Besides San Diego proper the area includes the cities of Chula Vista, Coronado, La Mesa, El Cajon, and National City. El Cajon and La Mesa are located along the main way to Imperial Valley, the rest of the cities mentioned being situated on the San Diego Bay. National City and Coronado can actually be regarded as suburbs of San Diego.

San Diego proper doubled its population each decade from 1910 to 1930. Population for 1910 was 39,578; it increased to 74,361 in 1920 and to 147,995 in 1930. Until 1880 development was rather slow. At the 1870 census San Diego had 2,300 inhabitants; in the following decade it added only a few hundred, totaling 2,637 in 1880. Even Los Angeles was a neglected and forgotten pueblo with not more than 11,183 (1880) inhabitants prior to the

TABLE I

POPULATION OF THE SAN DIEGO AREA

	1910	*1920*	*1930*	*1935*	*1940*
San Diego	39,578	74,361	147,995	177,306	202,038
El Cajon	.....	469	1,050	.....	.....
La Mesa	.....	1,004	2,513	3,190	.....
Coronado	1,477	3,289	5,425	6,673	.....
Chula Vista	.....	1,718	3,869	4,759	.....
National City	1,733	3,116	7,301	8,981	10,204

1910, 1920, and 1930 taken from the U. S. Census.
Estimations made by P. J. Webster (Bureau of Agricultural Economics, United States Department of Agriculture).
U. S. Census, 1940, preliminary returns.

building of railways in Southern California.

Railways opened a new period in the history of California. As for Southern California they brought her in contact with the San Joaquin Valley and the North on the one side, and with the East of the country on the other side. The tracks of the Central Pacific reached Bakersfield, at the southern end of the Great Valley, 1871; the Southern Pacific finished the railway to the Gulf of Mexico in 1881, and the Santa Fe (Atchison, Topeka and Santa Fe Railway) built a branch line to Los Angeles. The economic change brought with opening of the railways was the transition from wheat to fruit growing, which characterized the economy of the state for decades to come.

The decades following opening of the railway lines brought a strong migration into the valleys and lowlands of Southern California. Los Angeles, an insignificant Mexican pueblo not long ago, developed rapidly into a big city, and had 319,198 inhabitants by 1910. Thus fruit growing opened the economic expansion of the "South." Later exploitation of oil in the Los Angeles–San Bernardino basin gave a new impetus to economic development and population concentration, followed by a rapid industrialization.

With Los Angeles only a hundred miles north, San Diego was not able

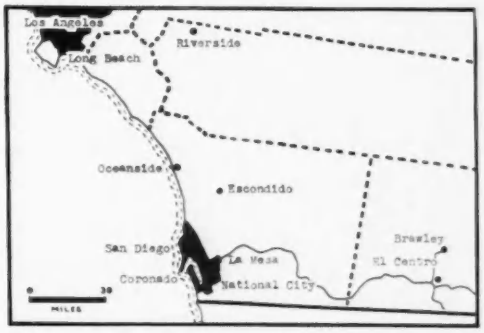

FIGURE 1.—Location of San Diego, Southern California. Highway 80 and a branch line of the Southern Pacific Railway connect San Diego with the rich Imperial Valley, and the cities of Brawley and El Centro. The Mexican border is a few miles south of Chula Vista.

to develop into a very large city. Very disadvantageous for its development was the partial isolation in the southernmost corner of the state, being the "last post" before entering the wilderness of Baja California and the Sonoran Desert. Growth of San Diego actually begins with the twentieth century. At the 1910 census it had 39,578 inhabitants.

Rapid development in the twentieth century is conditioned primarily by intensification and widening of the agricultural hinterland. When the Imperial Valley was taken away from the desert, and made suitable for agriculture through irrigation, San Diego became an important transit and shipping center for Imperial Valley fruit and truck crops. Highway 80 connecting San Diego with El Centro became

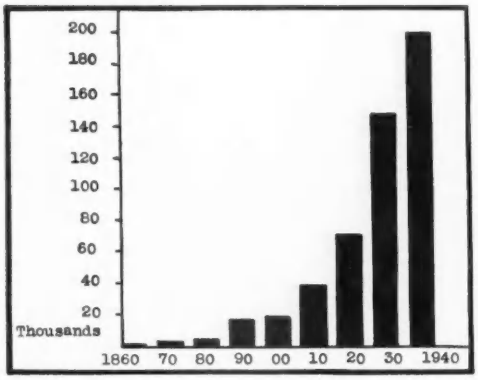

FIGURE 2.—Growth of population of San Diego 1860–1940. Total population in 1860 was slightly over seven hundred.

one of the two main routes into that rich agricultural region. Two other important factors of the development of San Diego were the establishment of the naval base and the fishing industry. Today San Diego is the tuna-fishing center for the southern Pacific waters. The canneries and packing houses attracted very early a considerable working population of Americans, and European and Mexican immigrants.

In 1930 San Diego proper reached the population of 147,995, being closely followed by Long Beach (142,032). Only 33,513 inhabitants, or 22.6 per cent of the total population, were California born, the rest being newcomers from other parts of the United States (61.6 per cent) or from other countries (14.6 per cent). Native population, born outside of California, consisted chiefly of people coming from Massachusetts, New York, Pennsylvania, Ohio, Indiana, Illinois, Iowa, Missouri, Kansas, and Michigan. Of the foreign born inhabitants, Germans, British, Canadians, Mexicans, and Italians were predominant.

Since 1930 population of the area grew at a rate that was characteristic for a number of Southern California cities, especially the medium-sized towns of Los Angeles County, but exceptional for the state as a whole. Publication of the 1940 census figure was a surprise even for those who knew about the large influx of eastern migrants, most of them from Oklahoma and Texas, into San Diego County. The official estimate of the San Diego population for 1939 (June '30) was 180,000. The 1940 census figures for other cities of the area, except those for National City, are not available yet, but will undoubtedly show an adequate growth. A promising sign of further development of the region is the increasing number of industrial establishments and industrial workers. From 1935 to 1937 the number of wage earners had risen from 4,233 to 7,422, according to the Biennial Census of Manufactures. On the other hand, population growth in Southern California urban areas tends not to follow the economic opportunities adequately, and there is already an acute problem of oversupply of migrant labor. It is very hard to say, therefore, how much of the population growth of Southern California is based on a firm economic foundation, and to how great an extent it represents an "overcrowding" through the unorganized and uncontrolled migration from eastern parts of the country.

TACOMA, LUMBER METROPOLIS

Gertrude L. McKean

FEW cities blend beautiful natural setting and strong industrial economy more admirably than does Tacoma, Washington. As one glides toward it by boat from the entrance to Commencement Bay, the city appears to spread across the apex of a deep inlet flanked by steep, wooded hills. Directly beyond looms majestic Mt. Rainier, its snowy outlines towering over 14,000 feet and unbroken by foothills. To the left lie the Cascades; to the right the serrate Olympics.

From the bay may also be seen the salient elements of Tacoma's industrial structure—an impressive and diversified array which explains why Tacoma, with its 107,000 people, leads all other Pacific Coast cities in per cent of population engaged in manufacturing. Except for the large shipments of wood products, however, Tacoma is essentially a city processing Washington raw materials for a Washington market.

History

Long before there was any thought of a city, the site of Tacoma was well known because of its fine harbor and its location at the junction of the Nisqually Trail land routes and Puget Sound sailing routes, which tapped the western Washington lowland. Fort Nisqually, established by the Hudson Bay Company in 1833, became a flourishing post surrounded by a prosperous agricultural colony, the nucleus of settlement in the Puget Sound region. Along the old Nisqually Trail moved most of the immigrants and supplies brought to western Washington in this early period.

The town's first industry was indicative of its later character. In 1852 Nicholas Delin built a small sawmill; the first cargo of lumber was shipped to San Francisco in 1853. Manufacture of barrels for sending salted salmon to San Francisco was begun at the same time. From 1852 to 1872 the town grew slowly, and its activities were based on raw materials from the immediate vicinity. After its selection as terminus of the Northern Pacific Railway in 1873, however, nation-wide attention was focused on Tacoma. Although this route was indirect, and traffic went first to Kalama on the Columbia River and then was re-routed north, settlers came in large numbers. Expansion of commerce and industry paralleled the rapid growth of population. Woodworking industries were by far the most important, although the outfitting business developed to supply grain ships, and a lucrative tea trade with the Orient was carried on. Diversification of industry followed as metal working grew in connection with the railroad and newly discovered coal mines at Wilkeson and as flour milling grew with wheat brought in by the railroad.

The most rapid industrial growth that Tacoma has known came in 1888 and 1889, largely due to completion of the direct transcontinental railroad across the Cascades. By 1890 Tacoma had fifty varieties of manufacturing, enough to satisfy practically all her needs, and was shipping 75 per cent of the wheat, flour, and lumber of the Sound. Wood industries made the greatest gain, although food processing, represented by grain milling and meat packing, experienced very rapid growth and began to assume its present im-

portance in the economic life of the city. A very significant addition to the industrial pattern was growth of copper smelting, using Alaska and Montana ores.

Although the railroad had brought an influx of settlers and capital, it encouraged over-expansion by providing the hope of a national market. Unwise investments, shortsighted railroad traffic policies, and speculation culminated about 1890 in a severe general depression, and hard times and retrenchment characterized the period from 1890 to 1895.

Klondike gold was the principal factor which turned Tacoma's development into industrial rather than commercial channels and pushed Tacoma into a secondary position on Puget Sound. In 1890 Seattle and Tacoma were practically the same size; by 1900, however, Tacoma had less than half the population of its sister city. The outfitting and supply trade, little of which was handled through Tacoma because there were fewer railroads and fewer ships available, gave Seattle impetus as a commercial center, while Tacoma developed more slowly as an industrial city.

By 1903 the basic pattern of Tacoma industry had been established, with the exception of wood pulp and chemical plants, which were added in 1928. Since 1903, although their relative positions have shifted and all groups have expanded, types of industries have remained essentially unaltered.

FIGURE 1.—The main business district of Tacoma, with Mt. Rainier in the background. The city is built on the coastal plain and low hills surrounding Commencement Bay, while Mt. Rainier commands the skyline and provides a natural setting unrivalled among industrial cities. (Courtesy of Tacoma Chamber of Commerce.)

GENERAL SURVEY OF INDUSTRIES

Although wood processing overshadows all other activities and employs nearly half of the city's wage earners, five secondary groups are represented in the industrial structure. These are food processing, electrochemicals and

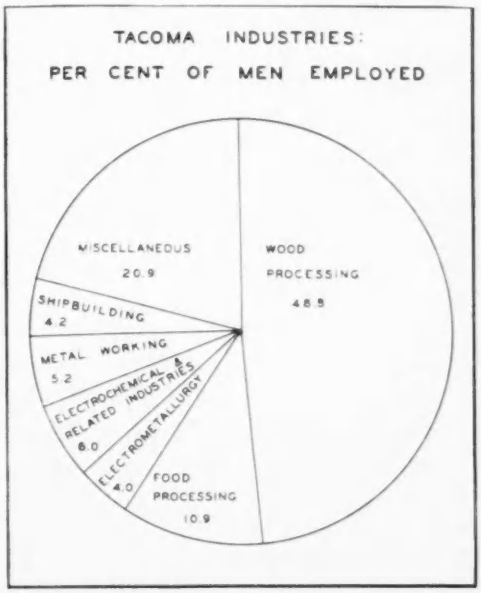

FIGURE 2.—Per cent of men employed in Tacoma industries. It is apparent from the graph that wood resources and electric power are the foundation of Tacoma's industrial economy.

related industries, electrometallurgy, metal working, and shipbuilding. Many diverse smaller plants, such as roofing, clothing, and glue manufacturing, supplement this pattern. Although they are important in themselves and include in many cases some of the city's largest individual establishments, these other groups are small in comparison to the dominant industry. Figure 1 shows the ratios developed as a composite of studies made in 1931 and 1935, and the 1937 Biennial Census of Manufactures. Figures available make complete comparison possible only in number of men employed.

WOOD PROCESSING

Few industries have played a more important part in development of a city than has Tacoma's wood processing. It has remained the dominant activity, completely overshadowing all others, since founding of the city in 1852, when the few settlers depended upon a small sawmill and when logs were dragged from surrounding hills by ox teams. Although in early periods lumber and cooperage stock were the only products, through the years the list has expanded until a wide range of more highly processed articles has superseded simple lumber manufactures. Today Tacoma is also known as a center for the making of shingles, plywood and veneer, sash and doors, cooperage, matches, furniture, and a variety of novelties, such as toys and gifts.

Together these industries involve 48.8 per cent of the workers and 24.3 per cent of the market value of products manufactured in the city. The census figures in Table I indicate their importance in the economic life.

Lumber mills and larger wood processing companies are concentrated on the tideland and narrow coastal ledge west of the bay. Virtually all plants have water frontage in order to facilitate sorting, handling, and distributing logs, and to permit direct loading onto ocean-going vessels. Tacoma is advantageously located in relation to present timber supplies, for chief sources of logs, most of which are Douglas fir, with some cedar and spruce, are the Cascade Mountains and the Olympic Peninsula.

TABLE I

	Establishments	*Wage Earners*	*Wages*	*Value of Product*
Lumber mills	19	3,918	$4,967,928	$14,932,578
Other wood industries	18	1,710	2,044,337	7,125,713

Spur railroad lines have been built into the Cascades, while timber from the Olympics is taken to the nearest tidewater point, made into rafts, and floated to market. Tacoma wood products are sold throughout the United States and enter international trade to some extent.

Twenty per cent of the plywood and veneer manufactured in the Pacific Northwest is made in Tacoma and production is expanding rapidly and encroaching upon the lumber market. Only a choice "peeler" log can be used, and increasing scarcity and resultant high prices of these logs in Washington are tending to cause the industry to shift to Oregon. Since only the outer layers of even these choice logs can be used for outside faces, the heartwood is either used for the center ply or is cut as common lumber. Bark and sawdust are made into "hogged fuel," which is either sold for domestic heating or used by the industry to generate its own steam power.

The export market is being developed under a system of rigid standardization. Pacific Forest Industries, Inc., which has its headquarters in Tacoma, was formed as a marketing agency to represent all producers in the Northwest. Output intended for foreign shipments is sent to a central warehouse where it is sorted, re-graded, standardized, and its quality guaranteed by the Association.

Tacoma is one of the largest furniture centers in the United States, although the industry has been considerably crippled in recent years by strikes and other labor difficulties. Both cheap and high grade furniture is produced, but emphasis is on well-built, high quality upholstered pieces.

FOOD PROCESSING

Food processing ranks second in importance in the industrial pattern,

FIGURE 3.—Lumber mill of the cargo type on Commencement Bay. Wharves piled with lumber and other wood products are the most characteristic feature of the waterfront. Logs are brought by rail or raft, are stored in the water until ready for use, are processed, stacked on wharves, and finally loaded onto ocean vessels or rail cars.

and accounts for 11 per cent of the wage earners and 20 per cent of the products by value. Aside from bakeries, dairies, and other purely local distributors, the principal food industries are grain milling, meat packing, candy making, and the making of specialties such as extracts and mayonnaise. Few of these are dependent upon the immediate environment for their raw materials, and in most cases the controlling factors in their location are transportation facilities for distribution, and an available market in western Washington.

Flour milling is the most important of these industries, and is the only Tacoma food product which enters foreign trade to an appreciable extent. Tacoma ranks fifth in the United States in flour production and is the foremost milling center west of Minneapolis and Kansas City. Wheat is brought from eastern Washington, Oregon, Idaho, and western Montana. At present the two largest mills are operating continuously, producing white flour primarily but also making coarse cereals, stock and poultry feed as by-products. Other smaller mills specialize in whole wheat, graham, and rye flour, and whole grain breakfast cereals. While the coarser flour and feed are used in Tacoma and vicinity, the market area for white flour depends upon world conditions. In years of drought it includes the eastern seaboard of the United States and the southern states; at other times it is principally in the Orient, South America, and Hawaii.

Meat packing ranks second among food industries. Cattle are brought from eastern Oregon and southern Idaho; hogs from the area between Nebraska and southern Idaho; and sheep from the Yakima Valley and slopes of Mt. Adams. About 50 per cent of the cattle and practically all of the hogs and sheep are purchased directly from farmers; the remaining animals are raised in company-owned feeding yards. At present 55 per cent of the output is cattle products, 30 per cent hogs, and the remaining 15 per cent sheep. Unlike flour, which goes into world trade, practically all the meat products are marketed in the Puget Sound lowland. Occasional shipments are made to Alaska and the Hawaiian Islands.

Tacoma stands high among West Coast candy producers, and although 90 per cent of the output leaves the city, expansion into outside markets is seriously hampered by over-competition and by distance from great metropolitan centers. As a result, the market area is restricted to western United States. Beet sugar from the Yakima Valley is used, and processed chocolate is imported from San Francisco. Tacoma is also a manufacturing and distributive center for fountain supplies, such as crushed fruits and syrups, soft drinks, wine and beer.

CHEMICAL INDUSTRY

Tacoma has been the center of the Pacific Northwest chemical industry since 1928, when two large pulp mills, two electrochemical plants, and an insecticide company were built. Although value of the products manufactured is high, these plans employ only six per cent of the city's workers.

Pulp manufacturing developed after 1928 as a result of increasing costs of production in eastern centers. Originally mill waste formed the raw material, but now logs and cordwood are used almost exclusively, since they proved to be cheaper and more satisfactory, and yielded higher quality pulp. Both sulphate and sulphite pulp is made. The sulphate type is used within the Pacific Northwest for paper making, while the sulphite is sent by barge to

Shelton and further refined for use in rayon and cellophane manufacture.

Development of pulp manufacturing attracted electrochemical industries because large quantities of chlorine and other chemicals are required both for reduction of the wood itself and for bleaching the fiber. These plants, the only ones in the Northwest, were located in Tacoma because of definite geographic advantages—proximity to pulp and paper mills, a cheap electric power rate, an abundance of pure water, and excellent transportation facilities. Salt, the other essential to production, is brought by boat from San Francisco. The principal products are liquid chlorine, caustic soda, acids, and bleaches, which are largely absorbed by the pulp and paper industry, and by oil hydrogenation and soap making. Although 90 per cent of the output goes outside Tacoma, only 45 per cent of it leaves the state of Washington, and most of this is used in the western states.

ELECTROMETALLURGY

Electrometallurgy, represented by the smelter, exceeds all other groups in value of products but employs only four per cent of the city's workers. This is the largest combined smelter and refinery in the United States and produces one-tenth of the nation's annual output of refined copper. Gold, silver, and copper ores are smelted; the amount of gold and silver handled is very small and it is sent in doré bars to San Francisco for refining. Most of the ore handled is copper, all of which is refined into sheets ready for a wire mill or rolling mill. Ores are secured from all over the world, particularly from Canada and the west coast of South America, and the reversal of seasons between these two areas helps to keep the supply steady when one source is closed during the winter.

METAL WORKING

The metal working industries are closely allied with wood processing and employ 5.2 per cent of the wage earners. They may be classified as follows: foundry and casting, railroad equipment manufacturing, structural steel processing, sheet steel fabrication, and machinery manufacturing. At present no primary iron reduction is carried on, although there is a possibility that electrical smelting may be established as part of the defense program.

The high degree of specialization which has developed in machinery manufacturing in Tacoma shows clearly its close relation to industries characteristic of the Pacific Northwest. A wide variety of lumber, finishing, and pulp mill equipment such as saws, veneer machines, hoisting engines, and pulp screens are manufactured and repaired. Ordinarily each company specializes in the making of a single type and accepts other contracts only in slack periods. Other shops specialize in making fishing tackle, trolling rigs, dredging machinery, and poultry brooders.

Except for machinery manufacturing, the metal industries primarily fill local needs and their market area is sharply restricted to the immediate hinterland. Raw materials must be imported, costs of production are high, and competition from larger plants in nearby cities is keen. Tacoma companies are too small to handle larger contracts, but expansion in order to be able to handle these orders is not justified.

SHIPBUILDING

Construction of small pleasure yachts and fishing craft is carried on in eight yards, but emphasis is on fishing boats for use in Alaskan waters. Because demand for such boats has proved to

be steady, the yards have been able to maintain constant production throughout the year, thus keeping their labor force employed.

Merchant shipbuilding was reëstablished in October, 1939, as a result of the decision of the Maritime Commission to rebuild the American merchant marine. Diesel engine, steel hull cargo vessels are being constructed. Two ways are now in operation and it is expected that more will be built soon. Present contracts allow a substantial subsidy to western shipyards because of their higher wages and heavier raw material costs, and although the Tacoma yard enjoys an advantage over eastern competitors because of its new machinery, permanency of the industry will probably depend on whether this advantage is sufficient to offset its higher cost of production.

MINOR INDUSTRIES

Every large city has many diverse industries which are too small to characterize its economy, but which distribute their products widely beyond the immediate trade area. In Tacoma these are represented by the manufacture of brushes and brooms, clothing, glue, paint and asphalt products, shoes, and leather and stone working. Many of these, such as the glue industry, furnish materials for plants in the major groups. Although collectively these companies are extremely important in the industrial pattern, individually most of them are small.

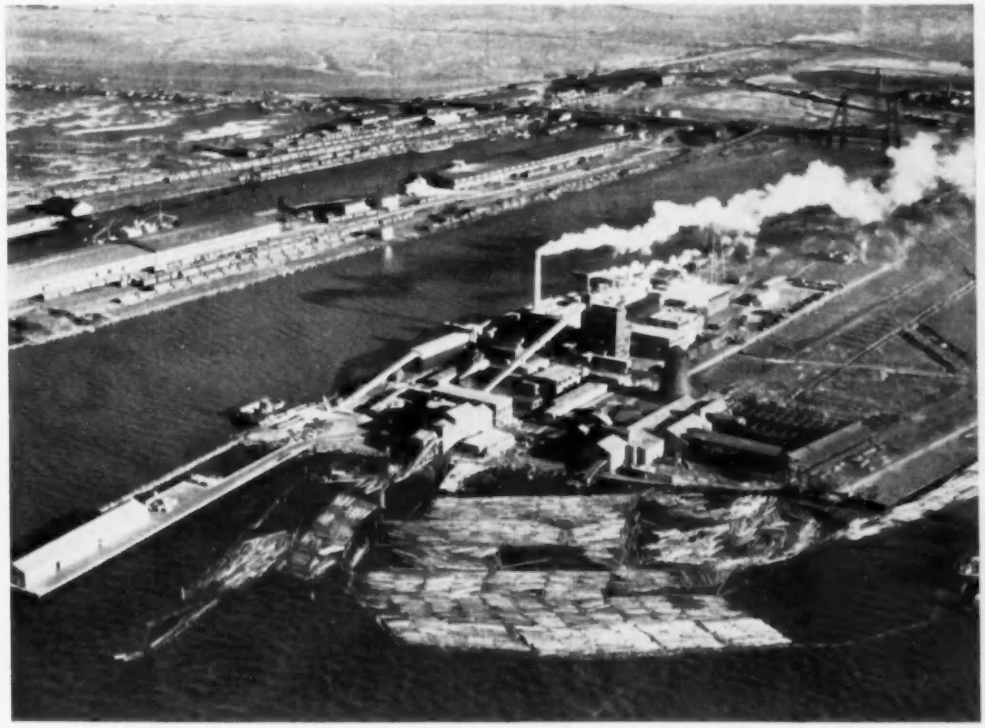

FIGURE 4.—The St. Regis Kraft Company, the largest pulp mill. In one continuous process, logs are broken down and converted into sulphate pulp. Wood pulp manufacturing has developed since 1929 into one of the city's leading industries. Its rapid growth was facilitated by the accessibility of raw materials, favorable power rates and expanding market, and a tidewater location. (Courtesy St. Regis Kraft Company.)

ANALYSIS

An analysis of Tacoma's position as an industrial city shows that it possesses many natural physical advantages, but that these are offset to a large extent by serious economic problems. The harbor is commodious and deep, with a minimum of 25 feet of water at all commercial wharves. The 19-mile waterfront has been improved by dredging of six navigable basins through the flats at the head of the bay. The channel by which the harbor is connected with the Pacific Ocean is everywhere wide enough and deep enough for easy navigation, although fog is a hindrance during part of the year.

Large areas are available for factory construction, and a municipal belt line distributes rail shipments in the principal industrial district without a switching charge. Warehouses and storage facilities are available for handling general cargoes, as well as more specialized equipment for handling both bulk and sacked grain, unrefined fish oil, fresh fruits and vegetables, and lumber.

Excellent transportation facilities link the harbor with its hinterland. Four transcontinental railways and 50 motor freight and passenger lines connect with the steamships plying to foreign and domestic ports.

Such a closely knit transportation system makes raw materials readily available. Timber is brought in by rail or by raft from the Olympic Peninsula and the Cascade Mountains. A constant stream of wheat, sugar, and livestock comes from eastern Washington, Oregon, and Idaho. Truck crops and dairy products are raised in large quantities in the tributary Puyallup Valley. Ores for the smelter are brought from all over the world.

A return cargo can always be secured, because the smelter, woodworking plants, and grain milling companies all provide bulky cargoes for outbound ships. From 85 to 90 per cent of the export tonnage passing through the port originates in the city itself.

In addition to these locational advantages, fuel and power are cheap and abundant. The low electric rate is an asset which has attracted industries requiring heavy power consumption. Ample supplies of coal are mined nearby, hogged fuel is prepared locally from mill waste, and an abundant supply of pure, soft water is provided.

Because of its long specialization in wood processing and gradually declining production in some branches, Tacoma has a reservoir of labor skilled in this type of manufacturing. This in turn has attracted other wood industries. Although presence of a skilled labor supply has been an advantage in this respect, however, the high wages paid place the Pacific Northwest as a whole in an unfavorable competitive position with other areas producing similar commodities.

Further development of manufacturing in Tacoma faces several serious problems, chiefly high labor costs, increasing raw material prices, and difficulty of marketing the finished products. Wages are higher in Washington than in competing areas. Although Tacoma is under no greater handicap in this regard than other cities in western Washington, the fact that labor is so strongly unionized and receives such high wages acts as a deterrent to influx of new industries, and by increasing costs of production, makes competition with other areas still more difficult.

Raw material charges are gradually increasing. Timber supplies, which once were taken from the immediate vicinity, must now be brought from long distances by rail or water. Peeler logs for plywood manufacture, particularly,

are being obtained to an increasing extent in Oregon. Although reforestation and sustained yield practices have been adopted to some extent, they are still insufficient to balance the amount of cutting, and gradual depletion is taking place.

Probably the most serious factor restricting expansion of manufacturing in Tacoma is limited size of the available market. Vigorous competition from Seattle and from Portland, together with physical barriers and distance from more cheaply than those from the Mississippi Valley.

Loss of the foreign market has been serious, since much of Tacoma's lumber trade was originally based on cargo shipments. In 1929 foreign exports of lumber totalled 374,163 tons, while in 1939 they were only 73,044 tons. The three factors primarily responsible for this decline are hostilities in the Orient, adoption of preferential tariffs within the British Empire, and general decline in world demand. At the same time, the

FIGURE 5.—The Pennsylvania Salt Manufacturing Company of Washington, one of the new electrochemical plants. It is located in the tideflats industrial area, on a site which combines the advantages of motor, rail, and water transportation, and favorable power rates. Growth of the electrochemical industry has paralleled that of the pulp and paper industry of the Pacific Northwest.

eastern markets, sharply restrict the Tacoma trading area and add to expense of production and distribution. Few companies are large enough to sustain nation-wide advertising; yet without it their markets are much restricted. Rail shipments all over the United States are made for products such as doors and plywood, but this wide overland coverage is unusual. Invasion of eastern markets through back haul shipments from Atlantic ports is more common. Canned goods, for instance, can be placed on the Atlantic seaboard

reciprocal trade agreement with Canada permits Canadian wood products to compete effectively in the domestic market. Although some of these losses have been counterbalanced by development of more specialized wood products and by intensification of sales in the domestic market, many of them remain permanent.

At present Tacoma industry is feeling the stimulus of war conditions. Pulp mills are operating at capacity because of the impetus given domestic production in cutting off imports from abroad

and relieving competition in the world market. This in turn increases the demand for chemicals. Resumption of shipbuilding and increased production by the smelter have had far-reaching effects on industry as a whole, and production of many minor commodities such as wood flour and glue is at capacity level.

The lumber industry has fluctuated with world market conditions, but the trend in recent years has been steadily down. From 1925 to 1938 the lumber cut decreased 67 per cent, due to stagnation of the building industry, competition from other building materials, collapse of the foreign market, distance from large metropolitan centers, and increasing costs of production. A transition is now being made from the production of raw lumber to that of more highly processed goods such as doors, plywood, and veneer, and Tacoma is experiencing the readjustments inevitable in such changes. The decline of ordinary lumber manufacture seems to be permanent, and the future of the wood industry in Tacoma rests with its more specialized branches.

SUMMARY

Tacoma is an industrial city dominated by wood processing, with five other significant types of manufacturing —food processing, electrometallurgy, electrochemicals and related industries, metal working, and shipbuilding. It is essentially a western Washington trade center, since raw materials are to a large extent drawn from this region, and manufactured products are chiefly distributed within the Pacific Northwest. The limited size of this available market is the greatest deterrent to expansion of manufacturing in Tacoma.

BOOK REVIEWS

SMITH, J. RUSSELL, AND PHILLIPS, M. OGDEN. *North America.* Published by Harcourt Brace and Company, New York, 1940. Price $4.75.

Improved in every aspect over the first edition, J. Russell Smith's "North America," for fifteen years the leader in its particular field, now appears in new edition with M. Ogden Phillips as co-author. Expanded in text, in illustration, and in richness and authenticity of material, the new edition includes new fact, new points of view, new appreciation of problems that North America must solve. Reorganized along new lines, it facilitates both teaching and learning, maintains the interest of the student (as the first edition did so exceptionally well), and sets new standards of serviceability and educational value.

As in the first edition, the approach is regional. The criteria for distinguishing the several regions are human use and human activity. Essentially the book is economic in its content, with considerable inclusion of political, demographic, climatic, physiographic, and other geographic elements necessary for satisfactory interpretation of human use and human life in each of the regions. It is encyclopaedic almost, in its essential economic presentation of fact.

For teaching purposes it is excellently organized; the material is critically selected; the point of view is studiously maintained; general principles and basic facts are emphasized. Relationships between environment and man's activities and standards of living throughout the continent are carefully developed. The type is easy to read, most of the illustrations are clear, and the charts and graphs significant. Very little material not strictly germane to the thesis of each part of a chapter is permitted to appear; every sentence or part of sentence has its bearing upon the principle or thesis involved. From the teaching point of view it is an excellent book—as the reviewer can testify from having used it.

For reference on almost every part of North America, the volume is unsurpassed, almost encyclopedic in its inclusiveness and authenticity. It should prove just as valuable, just as successful, in this function as in teaching. Our American public, as a mass, is woefully weak in knowledge, in first-hand information, on practically every part of the land not within its own immediate bailiwick. The average American has only impressions, often wrong at that, vague at best, about the parts of his country he has not seen. "North America" would replace impression with fact, lack of information with ample knowledge excellently arranged.

The new edition of "North America" is pretty sure to meet the approval of geography teachers throughout the country, and to maintain its eminent position among the textbooks needed in successful teaching, and in acquainting our people with the character of the land in which they live and the problems it entails.

W. E. E.

WORTHEN, EDMUND L. *Farm Soils; Their Management and Fertilization.* Published by John Wiley & Sons, Inc., New York, 1941.

In general, geographers are more concerned with the theoretical or scientific phases of soils science than with its application to farm practices and farm industry; but ever and again a geographer does have occasion to include some practical application of soil science, and then he needs just such a book as this "Farm Soils," which is a simple and clear presentation of soil practices and soil relationships on the farm, primarily for use in the classroom for the student in agriculture, and on the farm for the use of the farmer and his family themselves. The point of view of applied soil science is naturally and necessarily quite different from the scientific point of view embraced in the general text or reference on soil science, and consequently may have particular value for the economic geographer in his appreciation of the problems of agriculture and agricultural geography.

"Farm Soils" is not a general reference work on soils, on soil development, or soil classification, but is, as the title suggests, concerned primarily and almost entirely with the management and modification by fertilizer of soils on the farm. Any soils geography which it includes is merely incidental; but even so, it is a book that the geographer may well add to his shelf.

W. E. E.

Textbook of Geology, Part I, Physical Geology, by CHESTER R. LONGWELL, ADOLPH KNOPF, AND RICHARD F. FLINT, second (revised) edition; and Part II, Historical Geology, by CHARLES SCHUCHERT AND CARL O. DUNBAR, fourth edition, largely rewritten. Published by John Wiley & Sons, Inc., New York, 1941.

Every geographer likes, and needs, an authoritative inclusive geology on his shelves for basic reference and information. Such a geology must be up to date and well organized and written, general enough to present essential principles and detailed enough to embrace all significant fact. Such a geology cannot be included within one volume as is abundantly emphasized by this textbook, nor can one geologist spread far enough over the field to do justice to all the aspects and phases that interest the geographer.

Both parts of the work under review are revisions of superior merit; both of them have long engaged the favorable support of American scientists; both of them boast authorship numbering some of the best men in the science; both of them deal exhaustively but succinctly with the material with which they are concerned; and both of them are clearly written and well organized for both textbook and reference purposes. Each one of them constitutes a trustworthy reference for the field that it covers; very few geographers or geologists for that matter would have to seek beyond the covers of these two volumes for any information that he might desire.

The text of both volumes is clearly and interestingly presented; the charts, maps, and diagrams are pertinent and excellently engraved; the type is exceedingly legible and the paper yields no glare. In their physical make-up both volumes are exceptionally satisfactory. Each has its own index and its own appendixes. The lists of reading references at the end of each chapter are satisfactory in that they indicate where source materials may be sought.

It is safe to say that the popularity of the first editions of both these volumes has been enhanced by revision, and that they will continue as they have been in the past one of the best and most indispensable texts and reference books in the American field.

W. E. E.

VAN DE WATER, FREDERIC F. *The Reluctant Republic.* Published by The John Day Company, New York, 1941.

In "The Reluctant Republic," Van de Water presents a quasi-historical geography of Vermont in popular style and for popular reading. Interest in this kind of interpretation in this section of the country began with "Northwest Passage," continued with "Ethan Allen," and remains dominant in this volume, just as "Rome Haul," "Erie Water," and "Drums Along the Mohawk" did a similar service for the Mohawk Hudson depression.

"The Reluctant Republic" is written in excellent literary style, relates in rather full detail the story of Vermont's struggle to gain and hold its independence as a separate state, and preserves in romantic form the record of a period in American history, when the future of the new nation was being outlined by the struggles of its citizens to preserve certain fundamental principles of politics and government that were to endure for the nation as a whole.

We need a few geographers to write such books from a geographic point of view, to give popularity to geography itself and to demonstrate to our American public as a whole the rich content of the field of geography. The beginning is in sight, and perhaps the next generation will produce them.

W. E. E.

GAYER, ARTHUR D., HOMAN, PAUL T., and JAMES, EARL K. *The Sugar Economy of Puerto Rico.* xii and 327 pages and numerous tables. Columbia University Press, Inc. Price $3.75.

This work represents the first comprehensive study of the structure and operation of the sugar industry and its place in the economy of Puerto Rico. It is all the more significant because the industry is the most important one on the Island. It does not attempt an examination of all of the varied and complex problems of the Island—the study is concerned primarily with the sugar industry. However, a consideration of the general Puerto Rican economic problems was deemed necessary by the authors, in order to provide a setting against which the presentation of the more specific problems relating to the sugar industry might be made.

According to the authors the study was made at the suggestion of two land-owning partnerships in Puerto Rico who were engaged in the cultivation of sugar cane. The project was financed principally by capital coming from the United States. They were approached with the request that an objective factual analysis of the Puerto Rican sugar industry and its relation to the general economy of the Island be made. The authors were to interpret their findings in relation to controversial questions of public policy affecting the industry. This they have done admirably. The study is based on data available in 1936, except for some insertions and footnotes based on more recent events.

Messrs. Gayer, Homan, and James bring the important fact to the fore that they consented to undertake the commission on an explicit agreement that no part of the manuscript less than the whole would be published with their names attached, except with their consent.

According to the publishers, in Puerto Rico the elements of friction that everywhere characterize the working of human institutions, and the natural conflict of interests between different sections of the community are reinforced and aggravated by triple circumstances, namely: the sugar industry looms so large in its economy, investments from the outside play a substantial part in the cane growing and manufacturing aspects of that industry and last, this external capital represents ownership and control by those who, though of the same citizenship, belong to a different culture.

The organization of materials is as follows: Part I consists of a brief survey of salient aspects of the general Puerto Rican economy; Part II contains the detailed data on the sugar industry which the authors were able to accumulate in the time and with the resources at their disposal; Part III presents the authors' general interpretations of these data, and such conclusions as they felt justified in making. Nowhere is the presumption committed of attempting a defini-

tive solution of the Island's difficult social and economic problems.

Primary responsibility for various chapters belongs to the following men respectively: Arthur D. Gayer, Senior Economist and Economic Consultant, Board of Governors of the Federal Reserve System, Washington, is responsible for chapters 1–5 inclusive, 16, and 17 (in part). These are concerned with respectively: The Island of Puerto Rico, with sections on history, government, agricultural economy and the physical and climatic factors of the Island; Population and Social Friction; Agriculture in Puerto Rico; External Trade Relations; External Financial Relations; Sugar's Contribution to Insular Revenues; and part of the chapter on the Lafayette Project.

Paul T. Homan, Professor of Economics at Cornell University, had undertaken to write chapters 6–11 and 18–20 inclusive. These are concerned with General Aspects of the Puerto Rican Sugar Industry; Production of Sugar and Sugar Cane; Production Costs; Land Tenure; Relations between Mill Owners and Growers; Capital Investment and Earnings; Prospects of Economic Expansion in Puerto Rico; The Distribution of Income from Sugar; and The Land Question.

The third author, Earl K. James, has studied widely in South America and was editor of the *Chile Magazine* and the *Latin-American News Magazine*, 1928–33. He is concerned primarily with chapters 12–15, inclusive, 17 (in part) and section 3 of chapter 19. These are concerned with the following topics: Employment and Hours of Labor; Wages and Earnings in the Sugar Industry; Supplemental Incomes; Collective Labor Agreements; The Lafayette Project (in part); and the section The Wage Problem of the chapter on The Distribution of Income from Sugar.

The book is essentially one for the economist. It contains a wealth of statistical tables, one hundred and eleven to be exact. The geographer might be disappointed in the treatment of the subject, for about one page is devoted to the physical and climatic features proper, which are largely responsible for the presence of the industry on the Island. The book lacks a map which would greatly aid the reader unfamiliar with the general geographical features of the Island.

The authors have given an excellent analysis of their problems. Interpretative comment is made throughout the book. In all it is an outstanding treatment of an important problem.

The volume is attractively and substantially bound; printed in good legible type on excellent paper. A list of sources is cited which is not intended to be a bibliography of the literature on Puerto Rico and the sugar industry. The list furthermore does not mention all the works consulted in the preparation of the report.

IRA B. BERMAN

HARDING, JACK. *I Like Brazil.* Published by The Bobbs-Merrill Company, New York, 1941. Price $3.00.

In "I Like Brazil," Jack Harding paints a picture of that great country which seems to be America's best friend among the South American Republics, yet also seems the most vulnerable point in America's defense. It is a travel book pure and simple, and includes everything from government to gold mining, from night clubs to nuts, from water lilies to taxicab drivers, from the dice game *Bidu* to Brazilian coffee, what it costs to produce it, and the total yield and reserve of that delectable beverage bean. There is a great deal of geography, economic, political, and human in the book, none of it so labeled, not very much history, but a great deal of economics of a simple kind, and considerable sociology. Both directly and by implication it gives us a picture of Brazil that we need to know in this time of strain and hemisphere solidarity, so-called.

The root of Harding's Brazilian adventures began at Rio, covered most of the great territory, and ended again at Rio. He travelled on railways, on steamers, on airplanes, and on foot. Everywhere he went he talked with the people and studied their activities until he was able to interpret what they were doing and what they were thinking, something that all of us would like to know these days. The whole trip was made in 1940, so recently that there is nothing out of date about it, and everything has a bearing upon the present situation.

For summer reading when field work is the geographer's chief consideration, and classes and laboratories seem remote and indefinite, this is a good book to pack along with the rest of the impedimenta wherever the geographer is bound—to the seashore, to the mountains, to the fields, or to the fishing grounds, particularly if one is interested in South American affairs. It is not so profound or so ponderous as to become wearisome; neither is it so authoritative or so inclusive that it needs to be memorized. It paints an interesting picture without making the colors too vague or too clear. It has a pastel effect that may be even more accurate than something more scholarly and definite.

W. E. E.

ROMOLI, KATHLEEN. *Colombia: Gateway to South America.* Published by Doubleday, Doran & Company, Inc., New York, 1941. Price $3.50.

"Colombia Gateway to South America" is another of those books that it would profit us Americans to read this summer while we are waiting to assume military responsibility and naval protection for the integrity and solidarity of the Western Hemisphere. It is something more than a book with which to pass away the summer, though in its facile style and entertain-

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ing text it yields no suggestion of undue weight or disturbing profundity. Few Americans realize that Colombia has achieved a real attitude of real democracy, despite the diverse character of its terrain and its people. The author states that Colombia is a land of extremes, from the perpetual cold of the highest mountains to the monotonous heat of the *tierra caliente*, from a primitive camp in a wild jungle to an air-conditioned modern hotel, from a Spanish peon to an Indian prince, from banana plantations to coffee groves and herds of cattle on alpine pastures.

The author, Miss Kathleen Romoli, has done a fine piece of work in this account of a country to which we folk of the United States owe so much, and to which we may turn even more gratefully in the near future. Our American geographers owe her a debt of gratitude for giving us an exhaustive and detailed account of one of the most important of the South American states, a state where the nazism of Hitler or the communism of Stalin would be as forcefully rejected as it would in Vermont or Minnesota. Colombia is a state that will not endure either the philosophy or the practice of totalitarianism, so essentially democratic are her people and her economy and society. How this superior democracy has been achieved Miss Romoli's book develops in its almost 400 pages of charming text.

The book describes the landscape and the scenery of the whole country. It portrays the possibilities of its activities, the potentialities of its resources. It reviews the history and the evolution of economy in each of the many distinctive regions. It summarizes the character and attributes of the many kinds of people. It relates the diverse practices of agriculture in the manifold kinds of environment where it is practiced, and convincingly sets forth the opportunities for manufacturing and trade. It tells something of the poetry, of the politics and of the population problems. It points out the places of interest in the cities and the attractive bits of scenery everywhere in the country.

As a reference book for the student of South American geography and economics, it should find a place in every library and on the shelves of many of our businessmen and politicians. Nobody can be fully equipped with up to the minute information on Colombia who has not read this book. It is good.

W. E. E.